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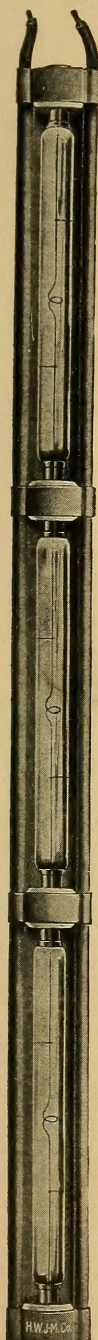

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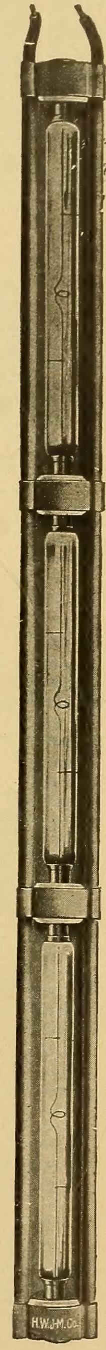
A partial distribution is made of the illumination before leaving the stretched out filament of the Linolite lamp, instead of the usual method of confining the source to a mere point from which all the light must radiate.



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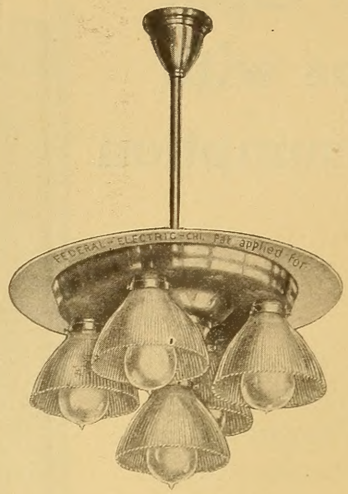

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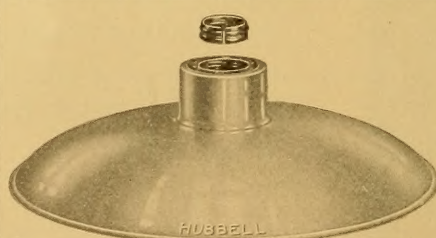

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WORTH LOOKING INTO

¶ IS ILLUMINATING ENGINEERING MAKING PROGRESS? A review of the field for the past year by Mr. E. L. Elliott is both encouraging to those interested in the development of illuminating engineering, and interesting to everyone who would like to see better lighting practices in force. If any one is doubtful as to the real growth and development of this new science let him read this record of a year's progress.

¶ THE NEW STREET LIGHTING. On every hand is heard the cry for more and better street illumination. The movement for the new street lighting is spreading over the country like a prairie fire. Mr. A. W. Leonard tells what Minneapolis has done in artistic street lighting, and Mr. Sydney C. Blumenthal shows that Baltimore, Md., is abreast in the procession; while those who are interested in uncompleted schemes for such improvement will find something worth reading in an article dealing with lamp-posts from the artistic standpoint.

¶ PROGRESS has been the word in every branch of the lighting field. Mr. Thomas J. Litle, Jr., tells what has been done in incandescent gas lighting; Mr. A. Cressy Morrison sets forth the present status of the acetylene industry; while Mr. Max A. H. Brünner describes the German gas industry at the beginning of 1909.

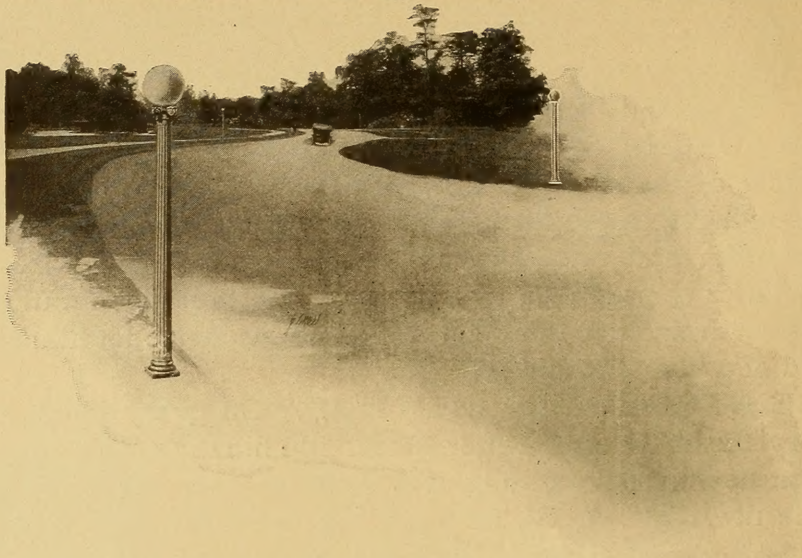
¶ Much has been heard in technical circles as to the need of more illuminating engineering data. Mr. J. S. Codman contributes a valuable article on this subject.

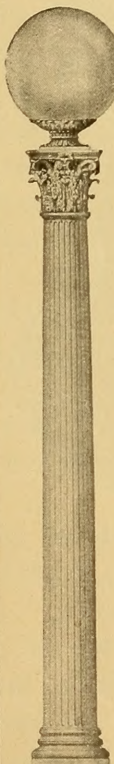
¶ LIGHTING FIXTURES are changing as well as lights. Commercial fixtures are described and illustrated in a special article on this important subject.

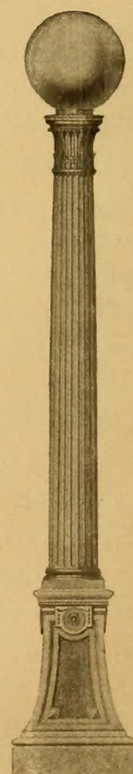
¶ PLAIN TALKS on Illuminating Engineering begin a series on street lighting. Those who want the pith of this subject in plain language will find it here.

¶ Besides the usual editorial and review departments there is a specially valuable series of letters from the various interests in the illuminating engineering field setting forth the records of the past year, and the prospects for the year to come, together with other interesting articles in this issue of

THE ILLUMINATING ENGINEER







The
Illuminating Engineer

Vol. IV MARCH, 1909 No. 1

CIVIC PRIDE

"Some love darkness rather than light because their deeds are evil."

Much just complaint has been made against the conduct of municipal affairs in this country. To discover the cause of an evil is to half secure its reform. The broad, underlying cause of abuses in city government is indifference on the part of citizens; in other words, a lack of civic pride. The city has been looked upon as merely a camp of a more or less temporary nature, in which the fortunes of time and chance have thrown the inhabitant in the vicissitude of his pursuit of wealth. There has been too little of the feeling that the city is the *home* in the larger sense.

It should be a matter of pride with every citizen that this larger home express the same high ideals which he seeks to embody in his own individual home,—with this difference, which places civic pride on a higher because more unselfish plane: that whereas the beauty and refinement of the private home are limited to the few who have access to it, the " city beautiful " affords gratification and uplift to the whole mass of inhabitants, poor and rich alike.

That which ministers to our pleasures is sure to be cherished. The ugly and the commonplace will never attract a new citizen, nor cause regret in the old at leaving. The peculiar fascination and enjoyment to be found in brilliant illumination is a matter of universal experience.

The newer and better street lighting is as sure to arouse civic pride as are neglect and slovenliness to produce indifference and disgust. There is no surer means of cleansing a city physically, morally, and politically than by giving it abundant light.

The relation between moral and physical darkness is far more than a figure of rhetoric. No move on the part of municipalities or civic organizations is so potent for political purification as the rapidly spreading sentiment for the newer and better street lighting.

Let the good work go on.

Light up, and keep lighted up!

E. L. Elliott.

A Year's Progress in Illuminating Engineering

By E. L. Elliott

This issue marks the beginning of the fourth year and volume of The Illuminating Engineer, and, conforming to custom, is made the occasion of a general stock-taking of the year's doings in the illuminating engineering field, and an expression of opinion from the various interests as to the outlook for the coming year.

Perhaps no general proof of the solid progress and steady advance of illuminating engineering is so significant as the opposition which has cropped out from various, and, in some cases, unexpected sources. A tree is known not only by its fruits, but by the clubs under it; where there are good persimmons stout poles are sure to abound. The great Agassiz once said that every great scientific discovery had to pass through three stages of existence: First, when every one said it was impossible; second, that it was contrary to religion, and, third, that everybody knew it before. Illuminating engineering, being a distinct step in the progress of science, must expect to pass through these three stages of growth. The first has been practically passed at the present time; but we still have vivid recollections of the time, not much more than three years ago, when the idea of a magazine devoted to the subject was considered, even by those best qualified from their position to understand the situation, as a chimera not worth serious consideration; and while we have none of the "I-told-you-so" spirit, it is a satisfaction to see

"Those who come to scoff remain to pray."

The past year has marked the definite progress of illuminating engineering from the first to the second stage of its growth. Within the last half of the year there has arisen no little murmuring against this new branch of applied science on the ground that it is opposed to the dogmas of various old-time commercial creeds. There is a certain type of mind which can never see any good in what is new or unusual, no matter what advantage it might ultimately be to them. This type of mind is naturally rarely found among the younger class, but is encountered among those whose success in days gone by has produced a more or less general ossification of the intellect; the brain can lose its flexibility as well as the bones. Their principles and ideas of business become sacred to them, like the graves of their ancestors, and they will complacently see the railroad of progress surveyed around them, so long as it does not disturb the hallowed ground of their fixed ideas.

That illuminating engineering is already rapidly emerging from its second stage, however, is shown conclusively by the recent change in attitude of the gas interests. When we pointed out a year ago that the electric interests, by their vigorous and hearty endorsement of illuminating engineering, were executing a flank movement upon the gas lighting industry which, if not soon intercepted, would cut off their principal sources of supplies, we were rather severely taken to task for these heretical utterances. But truth is truth, and will always prevail. The leading manufacturer of mantle burners and accessories has recently established an illuminating engineering department in charge of one of the acknowledged leaders in the profession, and at least three of the largest gas producing corporations in the country have practically recognized illuminating engineering, either by establishing regular departments, or by making practical use of the science in their work and their advertising. Papers on the subject have been presented at all the principal gas conventions and have aroused lively interest and discussion. Very decided and highly interesting developments in the field of gas illumination may be confidently expected during the coming year.

Another similar evidence of progress is the substantial interest that is being shown by the manufacturers of illuminating glassware. One of the oldest and best known of these recently announced that it had secured the services of a firm of

consulting illuminating engineers, and that hereafter all of its product would be made and sold on an illuminating engineering basis. Still another of the old and well-known makers has brought out a new line of glassware, which is being marketed on engineering lines. Less conspicuous are the glass makers, who are imitating the products of the manufacturers of legitimate scientific glassware, thereby acknowledging both the superiority of the wares which they are copying and their own incapacity to originate.

In the manufacture of lighting fixtures progress is also being made, although in this particular field there is probably the greatest amount of opposition at the present time. One concern, practically new in the business, which saw the trend of events and took advantage of the opportunities, has devoted its entire attention to the manufacture of commercial fixtures constructed on illuminating engineering principles, and has been shipping its product in trainloads; while many of the old-time manufacturers have been glorying in their past achievements, reviling the upstart illuminating engineer, and trying to figure out how they were going to get a new dollar for an old one. There is at least one case, however, of an old-line fixture manufacturer of first-class reputation having recognized and applied illuminating engineering principles to fixture design of even the most artistic order, and has, even within the short time since this policy has been followed, had substantial proofs of the wisdom of its choice. A considerable number of the others are beginning to whistle so loud to keep up their courage as to show that their surrender to the inevitable is imminent.

The use of illuminating engineering by electric lighting companies in order to give better service to their patrons, and thereby secure a larger measure of patronage, has made marked and highly satisfactory progress during the year. This has been noted in detail from time to time. The most recent development in this line is the move made by an Eastern lighting company to actually sell light, measured in candle-power hours, instead of electric current.

The Illuminating Engineering Society, whose early demise, like the good boy in the Sunday-school book, was lugubriously predicted by some of the wiseacres on illumination a year or so ago, continues to flourish, its last annual report showing a very comfortable cash surplus and a membership of practically a thousand, both of which have increased since. Through its initiative an international agreement upon a standard of candle-power is very near an established fact, and will undoubtedly be fully achieved before another year has passed.

The agitation in England which has been going on for three years looking toward the formation of a similar society has at last culminated in definite action. The preliminary steps have been taken toward the organization of an illuminating engineering society, which will start off with a membership including the best known authorities in both England and the Continent on subjects pertaining to illumination.

General interest in the subject may perhaps be best judged by the constantly increasing number of articles pertaining to its various branches which appear in the technical press, and also the abstracts from such articles, as well as original matter of a popular nature, that has appeared from time to time in newspaper and general periodical literature.

On the whole, therefore, the progress of illuminating engineering as a distinct branch of applied science and a separate profession has made very substantial and satisfactory progress during the past year, with every prospect for equally good progress during the coming year.

In the field of light-sources the past year has developed nothing radically new, but has been marked by the very rapid introduction of the tungsten lamp and the inverted gas burner. The facilities for manufacturing the former have been increased more than ten-fold, and still are unequal to the demand. In the construction of the lamp itself progress is noteworthy in the production of smaller units. The 40 watt lamp has been successfully produced now for several months in a form substantially the same as the carbon filament type—*i. e.,* in a bulb fitted with an ordinary short Edison base. The 25 watt lamp is also making satisfactory progress. Tungsten lamps in small units

and adapted to run on low voltage circuits in connection with small transformers, or "economy coils," are in process of evolution, and will doubtless become a commercial factor during the coming year. Prices have been reduced materially, and as the production increases and prices of manufacture are more definitely standardized, it is inevitable that prices will fall still further. Fixed charges and experimental work always constitute a large item in manufacturing expense in the early stages of any new article; as the quantity increases, the proportion of fixed charges reduces itself automatically, and both experience and larger production likewise reduce experimental charges.

The flaming arc lamp has made equal progress in the field of arc lighting with the tungsten lamp in incandescent lighting. It has at last been installed for special street lighting, and this use must surely largely increase in the near future. Perhaps the most notable evidence of its progress during the past year has been the large number of new lamps placed upon the market, of both foreign and domestic manufacture. The leading make of lamp of this kind has recently brought out an improvement which materially adds to the efficiency of the lamp, in a device for preventing deposit from the fumes of the carbons settling upon the outer globe and absorbing light; also the use of a prismatic inner globe, which changes the distribution of the light from the maximum at vertical to a maximum at about 45 degrees, thus giving a distribution much more favorable for street illumination. A lamp using two pairs of carbons with an automatic device for switching from one to the other is announced to appear in a short time. This will reduce the labor of trimming to practically one-half.

The luminous or metallic arc has undoubtedly made progress, but is not yet well out of the experimental stage. This does not mean that such lamps are not in successful operation, but that there is a comparatively wide field for research and improvement in their construction. The success that they have already attained, however, and the rapid introduction of the flaming arc, afford sufficient proof that the old type of carbon arc has had its day, and must give way to the newer forms as fast as conditions will permit.

The mercury vapor lamp has fully maintained its position in the general line of progress. A successful automatic starting device is now furnished, and the construction of smaller lamps, either with or without the addition of tungsten or carbon filament lamps to improve the color, constitute improvements that are of considerable importance. The peculiar quality of the light, which entirely unfits it for certain purposes by reason of its distortion of color values, but which gives as a compensation unquestioned superiority in enabling the eye to distinguish fine details, is becoming better understood and appreciated, with the results that this form of light has been very satisfactorily and successfully introduced for certain classes of commercial and manufacturing work, a field which in itself is sufficiently large to afford ample commercial possibilities. While those interested in other forms of electric lamps were slow to take the mercury vapor lamp seriously, there is no longer any room for doubt that it is a form of electric light-source which has an established value for certain fields of usefulness in which it is bound to make continued progress. The so-called "quartz lamp," which is simply a mercury vapor lamp in a quartz tube, which enables it to be run at higher pressure, with resulting higher efficiency and less pronounced color distortion, has not yet been commercially introduced in this country, but will undoubtedly appear during the coming year.

The vacuum tube light has undergone no marked changes during the past year, but has apparently extended its use, and at least held its own.

In gas lighting the inverted burner has been the chief feature of progress. It has now been thoroughly adapted to American conditions, and its reliability and practicability demonstrated beyond any question of doubt. So-called "gas arcs" constructed on this principle made their commercial appearance during the year, and having undergone the trial of use at the hands of the public, are destined to make very rapid progress during the coming year. It is rather curious to note the parallel progress in the production of light by gas and electricity. Thus, the in-

verted incandescent gas arc, in its distribution of light and higher efficiency, has striking similarities to the flaming arc lamp. While a single inverted burner apparently gives no higher absolute efficiency than the best forms of upright burner, it has a better natural distribution, and with its lower cost of maintenance, together with its novelty, has given to gas lighting a very substantial means of meeting the inroads which the tungsten electric lamp is in a strong position to make.

A new form of gas mantle having remarkable qualities in regard to strength and maintenance of candle-power has passed the experimental stage, and been tested out to a limited degree in practical use, so that it will undoubtedly become a commercial factor in gas lighting during the coming year. It is said that these mantles will run a thousand hours with a mere trifling reduction in light power, and that they are so strong mechanically as to even stand collapsing after they have been burned off. These features, if they prove to hold true in a commercial use, as there seems no reason for doubt, will afford an improvement in incandescent gas light that will be not far short of revolutionary. The fact is also worthy of mention that in the new inverted clusters or "arcs" much more elegant lines of construction are used, thus keeping the progress in the artistic side of light reduction on a par with the mechanical.

Small upright gas burners turned out as single units—*i. e.*, with burner, mantle and chimney complete and self-contained, and sold at so low a price as to be within the reach of every one (less than twice the cost of an ordinary 16 c.p. electric lamp)—have come into considerable use during the past year, and will certainly have a large field, and play no small part in maintaining the present position of gas and electric lighting. It is interesting also to observe that recent tests seem to prove that these small burners are the most highly efficient of any form of incandescent gas lamp. On the whole, it is safe to say that improvements in gas lamps during the past year have fully kept pace with improvements in electric lamps.

The acetylene industry has continued its substantial progress at its usual quiet but steady pace. A complete review of this particular luminant is given by Mr. A. Cressy Morrison, secretary of the International Acetylene Association, in another part of this issue.

Commercially, the past year is one that will be long remembered by the lighting interests of all kinds, in common with all other business enterprises. Not since 1893 has an old year gone out with such ardent wishes that another like it might not soon return. Much has been said by philosophers, particularly those callow seers who have had no experience, as to the value of the lessons taught by adversity; surely the stress and strain of the past year were not wanting in this respect. Among these was the fact, which was very clearly brought out, that the greater the business depression the greater the need for the use of publicity and other legitimate means of holding and securing business in the lighting field. Without exception, the lighting companies which maintained their new business departments at the same, or substantially the same, footing, either fully maintained, or increased their business during the year; while those who reduced, or suspended entirely, their new business departments, suffered serious contractions in their gross receipts. The logic of this principle seems so plain that it is surprising that it should be questioned by any one, and yet such was the case in many instances during the financial depressions of 1908.

Without going into details, progress during the coming year is likely to be most pronounced in the following lines:

First, the installation of better systems of street lighting, both from the decorative and practical standards.

Second, more aggressive action on the part of the gas interests to maintain the present status of gas lighting.

Third, more extended recognition of illuminating engineering principles in both the manufacture and sale of lighting fixtures and accessories.

Fourth, the continued increase in the recognition of illuminating engineering by those largely interested in the subject of illumination, including both users of light, architects, contractors, and the producers of luminants.

Electric Lighting in Minneapolis

By A. W. Leonard

Electricity, like all things commercial, comes as the result of a demand from the people. And, too, like things of real commercial worth, supply is forthcoming when the demand is greatest. Daily the housewife demands more, better and cheaper home lighting and low priced labor saving devices in order that she may eliminate her home drudgery; the merchant asks for better light that he may display his goods to better advantage, that his window shall draw customers and sell his goods; the manufacturer to increase the working efficiency of his force by lengthening daylight hours and in reducing to a minimum power losses, adopts the most modern light. Each—the housewife, the merchant, the manufacturer—strive for better results; the housewife in the interest of her home; the merchant and manufacturer in the interest of themselves, their organization and the general public, strive for the betterment of production methods for the attainment of a product of superior qualities.

And thus in the constant struggle for the uplift of standards in home and commercial life, daily the demand for the several uses of electrical energy become greater. This especially is true of all prosperous and growing communities; particularly is it true of the metropolitan city of Minneapolis.

But the natural growth of even the most prosperous and thriving city is not in itself advancement enough for the energetic public service corporation. *It* must lead in the great strides of progress. And to lead it must first of all form a definite, a conservative policy as between itself and the public in the community in which it operates. The co-relationship of interests in matters of public moment where the mutual betterment of city, customer and the operating company are at stake, is a factor which, until recent years, has not received its due amount of careful consideration.

The past growth of the Minneapolis General Electric Company, which supplies light and power in the city of Minneapolis, unhampered by the narrow policies of rate control by operating competition, is nothing short of phenomenal. It has increased its business over 300 per cent. in ten years; it has extended its lines in all directions to meet the constantly increasing demand for power and for light.

In its commencement under the present Stone & Webster management in 1899 the Minneapolis General Electric Company transacted an annual business of $300,000. Last year its business amounted to $1,008,415, which was about 10 per cent. increase over the previous year. This, in view of the fact that during 1908 power business was seriously handicapped on account of the universal financial depression, speaks volumes for the efforts made and results obtained by the concentration of one year's efforts in the development of home illumination throughout the residential districts.

With the early months of 1908 came the results of the financial unrest of the previous autumn. And despite the fact that Minneapolis probably suffered less from this world-wide business depression than any other city in the country, yet it cannot now, and could not then, be doubted that this had its effect in inducing production economy of manufacture and restraint of proposed projects of new construction, which at that time were many.

The prime functions of being of this city are two-fold; first, by nature of its geographic location it forms of itself a gateway of distribution to the markets of the world; second, because of proximity to vast undeveloped natural resources it necessarily must be a manufacturing center of no inconsiderable worth.

At this time also there appeared on the market the tungsten lamp. This lamp, through its economy of use in the home, has actually been the salvation of the electrical business as a lighting industry.

The advantages of the tungsten lamp are many; so also are the disadvantages. Not least among the latter is its weak mechanical make-up of filament, making careful handling necessary. Constantly through a slow process of development

THE NEW STREET LIGHTING IN MINNEAPOLIS

this delicate filament is reaching toward a goal of mechanical perfection, yet we cannot deny that this goal is some distance off, and even before mechanical perfection is reached many believe that an even more efficient illumination will become marketable.

Much has been written on the tungsten lamp; vastly more will undoubtedly be written. Here, however, we choose not to discuss the lamp nor its uses generally, but rather its use and result of its use so far as its introduction to the Minneapolis public are concerned.

First, its use as applied to street lighting. This deserves a word of description perhaps because of the fact that it was the initial installation for this purpose anywhere in America.

The advantage to a community, especially in a business locality, of a well lighted street after dark is no longer a matter open for discussion. Too many examples of benefits derived from such publicity are daily in evidence to need of further proof. Yet, not alone in the lighting of a street by night lies the whole effectiveness of a municipal lighting system. The ideal system comprises a well diffused light of even intensity with low cost of maintenance and operation; a system which by day is ornamental and pleasing to the eye, and one from a central station point of view which involves all possible of economic value. Such is beyond a doubt the system recently installed and at present in operation on the principal business streets of Minneapolis.

Each ornamental iron standard supports five large alabaster globes. Inclosed within each is a 100-watt tungsten lamp burning in an inverted position. One globe, directly on top of the standard, is known as the pilot light, because of the fact that after midnight this lamp is allowed to burn on until daylight. On each of the four ornamental supporting arms there is a similar alabas-

ter globe of slightly smaller size than the pilot lamp.

The standards are placed 100 ft. apart and eight to a block, and as the streets are of asphalt, are well crowned and nearly straight, a most picturesque appearance is present by night when the lights are thrown on by the switchman from a small key switch at the base of the post.

LAMP-POST IN MINNEAPOLIS

To meet the expense of first installation the property owners on the streets where this model system of lighting is now used were taxed $2 per front foot. And to maintain the posts and lighting each property owner is charged $1.25 per year. This maintenance includes the current used, lamp renewals, replacement of broken globes, painting of posts and turning on and off lights three times every night; that is, turning on all five lamps at sundown, turning off the four side lights at midnight, and the pilot light at daybreak. The maintenance cost of each standard per year is approximately $78. The first installation cost of these posts was $140.

The use of the tungsten lamp for such purposes has proven a success beyond a doubt. It was the first installation of tungsten lamps for such purposes, and for any purpose it was the first time these lamps had been installed in an upright position. But after eight months' severe test under the most trying of conditions figures prove that this system is far superior to any yet installed.

Careful records of conditions and of results were made during six months, and these prove that not only was the tungsten lamp a success from the start as a street light, but daily, because of its nearer approach to mechanical perfection, it is proving a better and more economical lamp both as concerns its use by the public and also by the central station in meeting and coping with competition. During this test the average lamp-life was 725 hours; 78 lamps burning 1380 hours and many lamps of the first installation are still burning—over 3500 hours. For the first three months the average life was 349 hours, and for the last three months of test it was 858 hours.

So much for tungsten lamps for street lighting. Now a word as to its introduction, its use and result on the home.

As before stated, the result of general business depression, both universal and local, made necessary the exertion of efforts along other lines than power busi-

ness at the beginning of 1908. The only other field was the home. Here efforts were made and results successfully accomplished. At this time, only one year ago, the tungsten lamp was becoming generally used, and in Minneapolis about 2000 had been placed in stores and homes. Its absolute mechanical failure at this time proved almost its ruination. And the prejudice created through the mistake of placing a commercially impractical illuminant on the market has not yet, in spite of all efforts on the part of operating companies, been lost sight of by the public.

The unquestioned advantage of its superior lighting qualities, its longer life, and last but by no means least, its great economy of consumption of current, made it of public demand despite its disadvantages; and with eagerness it was seized by the public, but its use was not at this time urged by this company. Not until after an exacting series of tests had been made was this course taken.

As soon, however, as the tungsten lamp became of American manufacture—and not before—did this company advise its customers to use it, that it was to their advantage to do so. It was then advertised, and the supply for six months was far behind the demand. And constantly that demand is increasing, but to-day supply keeps pace with demand.

Any dollar saving device does not in itself need a very urgent argument to assure it of great demand once the people are assured that it is for *them* a dollar saver. To make this assurance secure, however, often requires no small amount of convincing facts. Especially was this the case in the introduction of the tungsten lamp; because, as is now well known, this is the first instance of note where a supplying company has sacrificed its earnings in the interest of the public and for the good of the community. That this company has succeeded in making convincing evidence of the facts presented by the advantages of the tungsten lamp needs no further argument than is contained in the statement that in one year the use of these lamps in Minneapolis has increased from 2500 to over 32,000. One year's campaign with special effort in the direction of the residential consumer did this; it bids fair to greatly outdo this record before the present year elapses.

Generally speaking, the prospects for 1909 along lines of electrical interests are most encouraging. In Minnesota and throughout the middle Northwest building is progressing rapidly, and the two factors of general interest which point to the degree of success and to stability of prosperity in this community—wheat and lumbering interests—passed 1908 at a very high mark.

As for itself, the Minneapolis General Electric Company does not hesitate in saying that 1909 opens bigger fields for development, greater opportunities for advancement, than any other year previous; and as to the Minneapolis public and its city, it has greater faith and pride, and it sincerely believes that its relations with its customers daily become closer and of a nature which develops harmony beneficial both to itself and to Minneapolis.

It is interesting to note that at this time the appreciation shown by the public as regards the advanced attitude of this company in the policy of helping, through efforts to reduce lighting expense, the consuming public. And public opinion is an asset of no small intrinsic value.

Public Lighting in Baltimore

By Sydney C. Blumenthal

By advertising, the Superintendent of Lamps and Lighting, Robert J. McCuen, has begun a crusade to still further improve the illumination of Baltimore's streets, and with this end in view is desirous of purchasing burners for gas and gasoline lamps if they can be had. The municipality owns the present lighting equipment, and these burners are to be used in connection with the same, and if there is a more modern type of street lighting fixture than now in use by the city informa-

FIG. 1.—ILLUMINATION BY ENCLOSED ARC LAMPS, BALTIMORE STREET

tion is particularly desired on the subject.

The underlying object, briefly stated, is that by owning its entire equipment the city will be in a better position to create competition and naturally improve its lighting system. The burners now in use are owned by the American Lighting Co., as are also the naphtha lamps and posts, the contract for which has just gone into effect and does not expire until March 1, 1910. In the meantime, however, Superintendent McCuen will carefully consider all propositions and suggestions from manufacturers, &c., for the betterment of the service, so as to be in readiness to make recommendations at the expiration of the present contract.

The city is placed at a decided disadvantage as regards lighting its streets, in that it must provide adequate illumination and receives no material assistance from the merchants doing business on the principal streets in the way of brilliant electric signs extending over the sidewalk as do other cities, on account of the fact that the law as now in force will not permit electric signs of any description to extend more than 2 ft. from the building line, and for this reason, therefore, the city must supply ample light without the assistance that the merchants would surely render by erecting electric signs to help illuminate the thoroughfares were they not powerless to act.

The splendid illumination of Baltimore street, the busiest and main thoroughfare of the city, deserves for it the name "Great White Way," the arc lamps, a general view of which are shown in Fig. 1, being spaced approximately 60 ft. apart and arranged in pairs on ornamental posts. The lamps are placed on both sides of the street in zigzag fashion, and arranged so as to evenly distribute the light over both sidewalk and street, leaving no dark shadows to mar its recognized daylight appearance. The photograph, which was taken at a late hour of the evening,

FIG. 2.—ILLUMINATION BY MAGNETITE ARC LAMPS, BROADWAY.

shows with what brilliancy the street is illuminated, and it is clearly seen how accurate and distinctive the wares in the various show windows stand forth without the assistance of light from their own illuminants.

Since the lighting of this street from Paca to Jones Falls has been accomplished, the merchants of West Baltimore have organized an association, the object of which is to have the single arc lamps now in use replaced with the newer type of double lamp and located a sufficient distance apart so as to continue the "White Way" throughout the entire western business district. Already $2500 has been raised toward the installation of these lamps, and the balance, it is understood, will soon be forthcoming, when steps will immediately be taken to extend the double arc lamps for a distance of 27 blocks.

Recently all the overhead wires on South Broadway have been placed underground, and at the same time an entirely new system of arc lamp illumination has been placed in service. As the name implies, Broadway is to Baltimore what Pennsylvania avenue is to Washington, and with the new lamps now in position presents a most dignified appearance. The single arc lamps which are of the magnetite type are most eminently satisfactory, and as shown in Fig. 2, looking down Broadway from Baltimore street, it permits no possibilities for imagination. This street, the center of activity of East Baltimore, is liberally patronized, and the merchants and residents are most enthusiastic over this valuable adjunct to their territory. To this new system of illumination, then can be attributed the increased crowds that nightly avail themselves of the brilliant illumination to purchase their requisites, and has inspired the merchants themselves with the spirit of more light.

A model installation of gas illumination is shown in Fig. 3. It is a view of the

FIG. 3.—ILLUMINATION BY CLUSTERS OF GAS LAMPS, NORTH AVENUE BRIDGE

North Avenue Bridge over the Pennsylvania Railroad tracks, showing the highly ornamental and artistic gas posts which illuminate this bridge. These lamps were erected to take the place of arc lamps on account of their more graceful appearance, and are arranged in clusters of four lights, each burner giving 50 candle power. Up to the present time they have given excellent service and are much admired.

Beginning to realize the necessity of more light about the station of the Pennsylvania Railroad, plans are now being formulated for the installation of the most modern street lamp on the street immediately surrounding the station. Strangers now coming to Baltimore will be greeted with brilliant illumination, which first impression goes far toward creating a favorable opinion of a city. It has been recognized that it is very important from a commercial standpoint and will do much toward placing Baltimore on a plane with other cities of its size. Much depends on the first impression created by an individual; cheerfulness and attractiveness are potent factors in the accomplishment of success in an individual, and the same conditions apply to a corporation such as the city of Baltimore. The erection of these lamps will supply a long felt want on the part of those who live in the immediate vicinity of the station, which has always been dimly lighted. Superintendent McCuen also has under consideration the illumination of 16 streets running parallel with and intersecting Baltimore street, and will place approximately 250 arc lamps in addition to those already in place, which will make the business district of Baltimore the best lighted of any city in the United States.

FIGS. 1 2 3 4 5 6

Some Critical Comments On Lamp-Posts

The lively interest that is being manifested throughout the country in the subject of better street lighting brings up the question of the artistic treatment of the supports for light sources. Such supports usually have the form of either posts or brackets, with a cross between the two designated as the mast arm. The lamp-post is susceptible of a high degree of artistic treatment, and may be classed in a general way along with architectural sculpture. The same variety of materials is available, namely, stone and metal; the latter either wrought or cast, or a combination of both.

Posts to be used in connection with a building, as for example at the entrance, naturally need to harmonize with the architecture; but when intended for street use are entirely independent of such restrictions. Not even fashion in woman's dress is so generally and slavishly followed as are fashions in architecture. In each case recurrences of particular types is as inevitable as the change of the seasons. Just at the present time the classic type is the prevailing mode; and bold, indeed, would be the architect who would plan a building of the Romanesque order, which had complete domination a quarter of a century ago.

Classicism shows its effects in every phase of construction, lamp-posts not excepted. The illustrations of recent designs give evidence of this influence. The standard in every case is either a column of one of the three orders of Grecian architecture, or a modification.

In No. 1 the simplest, or Doric order, is used. The base is a particularly pleasing adaptation of classic motives to the purpose in hand. The three-branch standards at the top, however, are far from satisfactory. The urn on top of the column would not naturally be used to support a three branch candle-stick. The difficulty of adapting any device for holding multiple lamps on top of a Greek column is probably unsurmountable.

In No. 2, the single globe at the top is

in excellent proportion to the lines of the column and base, which form a very pleasing whole.

No. 3 shows the use of an Ionic column of good proportions, mounted upon a base which, though artistic in itself, is of doubtful propriety as a support. The classic column will always be associated in the mind with architectural construction, and this naturally presupposes a solid foundation. The urn and its broad cover between the globe and the capital is a discordant feature; it would be much better were the globe supported by the urn directly.

No. 4 is a particularly successful design for street use. The lines are in excellent proportion, and the classic spirit is maintained throughout, the globe resting upon the Corinthian capital in a natural manner.

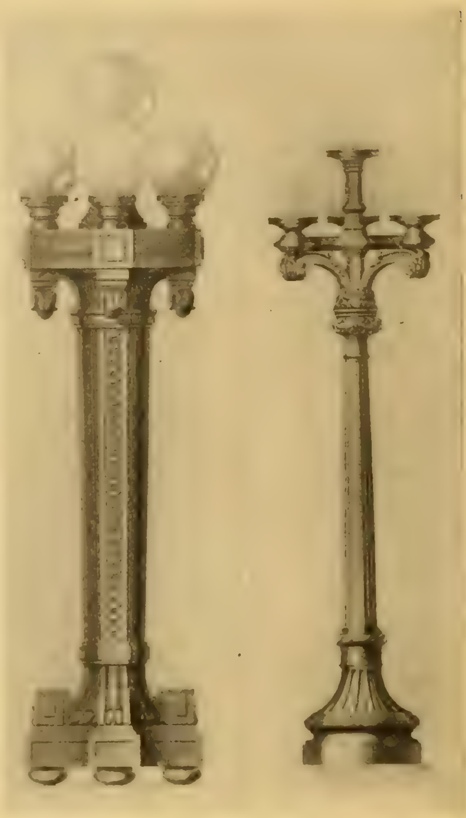
No. 5 is a distinct modification of the Greek column in that the flutings are twisted, a device much admired by Italian designers in the Middle Ages and even at the present time. The elaborate and rather large base fits this construction better to use as a portal lamp than as a street fixture.

No. 6 shows the Ionic column in practically its simplest form, surmounted by a cluster of lamps, which is probably as successfully designed as conditions will permit, although there is the same fault here as mentioned in the case of No. 1.

No. 7 is manifestly an architectural design which would scarcely be considered for street use. The proportions are excellent, provided it is to be used in connection with a building of imposing architectural features.

No. 8 is clearly an anachronism. The base is Roman, if anything; the fluted column, Grecian; the capital and curved brackets modern, partaking of the Empire period of design, while the supports for the lamps themselves are Gothic.

There is a question that has apparently not yet been satisfactorily settled as to who should design a lamp-post. It is not



FIGS. 7 8

a building, and, therefore, not strictly within the province of the architect. It is not primarily a piece of sculpture, although it may receive sculptural decoration, and, therefore, not strictly within the field of the sculptor. Its æsthetic appearance is purely a question of art, which puts it beyond the legitimate field of the purely practical illuminating engineer. Perhaps a combination of the three might produce the desired results. At any rate, it must be borne in mind that the design and the execution are two entirely different things, and that the manufacturer of a post must no more be held responsible for the design than is the stone-cutter who reproduces in marble the clay model of the sculptor.

Progress in Incandescent Gas Lighting During the Past Year

By Thos. J. Litle, Jr.

During the past year there has been a marked increase in the use of the inverted system; not because the total flux from an inverted mantle is more than from the upright, but because the greater part of the light is in the lower hemisphere, and the ordinary user thereby gets greater satisfaction, even though no attention be paid to reflecting shades of any kind. The commoner types of glassware which are used on the cheaper burners cannot be considered to aid in directing the light, but, rather, serve only to protect the mantles from air currents. Even with this type of globe a better lighting effect is obtained than would be with a straight glass chimney on an upright burner. The reflectors have been found, however, to be extremely useful when properly applied to inverted burners. This is particularly marked in the lighting of store windows where high concentrating reflectors are very desirable. The inverted mantle being of rather small dimension it is particularly susceptible to reflection, inasmuch as the light is now concentrated and consequently more nearly approaches the focus of the reflector, which cannot be said of other types of illuminants with rather an extended source.

It has been now very generally demonstrated that the inverted mantles are very much stronger than the upright, and this allows of their being used in places where the vibration proves to be too great for the older type of upright mantles; its added strength is probably due to its smaller mass, and takes up the vibration from the fixture proper more readily than the longer hanging upright mantle; furthermore, the mantle is in itself attached rigidly to the carrying magnesia ring, and there is no swaying or bumping motion, as is the case with the upright, which so often causes it to crack and sometimes break off at the gauze line at top of burner.

Thousands of the passenger coaches in America are now lighted with the inverted gas system, and the standing orders on most of the larger roads are to the effect that all of the new coaches shall be so equipped, as well as coaches as are being renovated.

Gas illumination has paralleled the electric lighting in respect to fixture design. For instance, we see the metallic filament lamps being used on specially designed fixtures and the lamps equipped with prismatic glass reflectors. We see almost identical equipment used in inverted gas burners, the only difference being that the reflectors here used have been provided with non-breakable metallic necks, which will be found necessary on account of the high breakage where the glass necks were used. These inverted fixtures are self-lighting, with pilot system of ignition, by using a single chain suspended from the fixture controlling all burners.

In inverted cluster lamps a single piece of glassware has not yet been sufficiently used to demonstrate its success, but indications are that this type of lamp will be very largely used as was the upright type of cluster lamp, known as the gas arc.

Illuminating engineering seems to play an important part in gas illumination, and some of the comparisons made between the cost of gas lighting and electric lighting are most interesting, but as both the electric and the gas systems are now using reflecting shades almost exclusively, these comparisons are very difficult to make directly and while we may approximate illumination from a polar curve given out by a photometric laboratory, if the distance from the plane to be illuminated to the light source be the same as was used in the laboratory in making the test, it by no means follows that for other distances simple calculations from these figures should always be correct; in other words, it would seem that from the data at hand on lamps equipped with reflectors that we are limited to the calculation of illumination in

spherical rooms only, and so it would seem that we must reform our testing methods by eliminating a great deal of our calculating and do more direct testing in order that illuminating engineers may really know and determine accurately the comparative cost of illumination by means of the various types of gas and electric units now on the American market.

The Present Status of the Acetylene Industry

By A. Cressy Morrison

The acetylene industry at the beginning of the year 1909 is just entering upon the era of its great development. In 1907 and 1908 very serious restrictions were removed which had for many years hampered the industry, and in many cases rendered its progress impossible. The insurance rules requiring the outside installations of acetylene generators were rescinded so that an acetylene generator can now be placed inside of insured premises. This change constitutes a recognition on the part of the insurance world that acetylene is less hazardous than the illuminants which it replaces. The insurance rules were also modified so that calcium carbide may now be stored in insured premises in sufficient quantity for all purposes without restriction, and calcium carbide in large quantities, when stored in a separate building, can be so stored without unreasonable restrictions as to location.

The United States Government has reversed a ruling which absolutely forbid the transportation of calcium carbide on passenger vessels, and now permits such transportation freely. The railway companies after a thorough investigation of the question of the transportation of calcium carbide decided to remove all restrictions in regard to such transportation, the records showing that for many years vast quantities had been shipped without disaster being caused by it. These facts wherever known have removed from the public mind much of the prejudice which previously existed against acetylene. In addition, the public, having become familiar with acetylene because of its enormously increasing use, has found in actual experience that it is quite as safe as any other means of illumination. The aggregate result of these influences is beginning to be shown in the very rapid expansion of the industry in all directions.

The manufacturer of apparatus designed to utilize acetylene is encouraged because he believes the industry has become staple and permanent. The user of acetylene in any of its various fields has become more confident and buys more freely.

It seems, therefore, that the throbbing impulse of progress which can now be felt by all those closely in touch with acetylene is based upon sound principles. During the past year it is probable that not less than 30 per cent. more generators for home illumination have been sold than in any previous year.

The United States Government has concluded several investigations which demonstrate the value of acetylene for light houses, beacons and buoys, and in this particular field, because of its reliability and the concentration of the candle power at the focal point, acetylene is destined largely to replace oil in the most important locations. The recognition of acetylene in this field is not confined to the United States, as Canada preceded our own government in this investigation, and its adoption by the Canadian Government is rapidly becoming general. Most of the South American countries are using acetylene for this purpose, and the same can be said of the countries of Europe, especially Norway and Sweden, and South Africa is now earnestly taking the matter up.

Acetylene is rapidly becoming the standard light for headlights, and has become practically supreme in this use for automobiles. In railway lighting acetylene is meeting competition successfully on many of the leading railroads, not only as a headlight but for car illumination. A

change of method has been forced upon its competitors in this particular field which would undoubtedly have been slow of development had not the supremacy of other means of illumination been seriously menaced.

A movement of notable importance has been the gradual recognition by the scientific world of the great utility of acetylene in special fields of illumination, notably in diagnoses and surgical operations. It is also proved remarkably effective in dental work.

The introduction of acetylene in the mines of the United States by means of miners' lamps has during the past year taken a decided step forward, and as acetylene presents the remarkable advantages of a smokeless, high candle power illuminant at less cost than either candles or oil, and as the arguments in its favor are unanswerable, its destiny in this direction seems to be the same ultimate supremacy which it has ascertained in the automobile field.

Acetylene is now replacing many of the street lights used by contractors where a very large candle power is required in construction at night. In hundreds of special fields acetylene has proven to be extremely advantageous, and is making a place for itself because of its better adaptation to the end in view. While these new fields are adding an enormous impetus to the business, the progress in domestic institutional and hotel illumination is so great that a very large per cent. of the business is still to be found in this progressive field.

A review of the subject inevitably forces the conclusion stated above that the acetylene industry is upon the threshold of its greatest advance and that the next few years will show a forward step so marked that the older industries must look to their laurels.

I earnestly maintain that there is a great opportunity for the illuminating engineer in the acetylene industry. The other fields have attracted more attention and more young men; some of them are now overcrowded. Acetylene illumination being largely found in the country, has not been considered seriously by the illuminating engineer. Up to the present time, so far as I know, he has given no attention whatever to acetylene in those other fields which promise so much, and in which the pathway to success has scarcely been more than indicated.

The German Gas Industry at the Beginning of 1909

By Max A. R. Brünner

At a time when the gas industry in its various forms is in danger of being handicapped by the proposed Government tax in the German empire it may be of interest to glance over present conditions. The following statistics cannot be considered complete, because data is available only from municipal plants. If the gas tax becomes law there will be available statistics also from the many private plants.

A fair basis of judging the amount of gas produced is to consider the consumption of coal. This amounted in seventeen of the larger Prussian cities having municipal plants to 1,924,550 tons; while the total use of coal for all purposes was 126,000,000 tons. Considering cities having 5000 inhabitants and over, of which there are nearly 2600, 1176 own their own gas plants. The largest is, of course, in Berlin, which produced in the past year 8,260,200,000 cu. ft. Cologne comes next, with 1,623,800,000 cu. ft.; Charlottenburg, a suburb of Berlin, produced 1,397,880,000, and so on. The total length of pipes in the first city is about 868 miles, that of Cologne 310 miles, which is the distance between that city and Paris.

Of the total number of gas plants, nearly two-thirds are owned by cities. Of cities having over 20,000 inhabitants, 81 per cent. have their own gas plants; and the recent tendency is toward municipal ownership rather than private. This applies not only to new plants, but many private ones change their ownership and become the property of cities. Of the private plants a large portion are in the

hands of five big concerns. The largest is in Bremen, maintaining 41 plants. The New Gas Company, Ltd., in Berlin, owns 21, and another in Magdeburg 15.

In some cases a number of nearby towns and villages are furnished with gas from a municipal plant; as the City of Dessau (50,000), which serves 44 other places. In 1908 a sixth concern was founded, which builds gas plants for cities and then takes them on lease. Up to 1906 over 20 plants were built by this concern. Many of the private plants have to pay considerable in taxes to cities, and are bound to furnish gas for municipal lighting gratis, or at reduced prices.

As regards the municipal plants, the absolute amount of net profit has risen in the past few years along with the increased income for each 1000 cu. ft. of gas. The former is due to the increased sales of gas, and not to a reduction of the cost of production nor to increase in price of gas. The net profit in 1905 in Berlin was $2,673,000; in Hamburg, $1,215,000; in Dresden, $558,900. In 40 larger cities the gas consumption per head rose from 1942 cu. ft. in 1894 to 2154 cu. ft. in 1899, and to 2507 cu. ft. in 1905. In the same towns there was an increase of gas consumed for heating and cooking from 15 to 25,5 and 43 per cent. in the above years. Gas for this purpose is in most places lower in price than that for lighting, except in Berlin, where it is $0.90 per 1000 cu. ft. In other towns there is a considerable reduction; for instance, in Dusseldorf it is $0.55 per 1000 cu. ft., while the gas for light costs twice as much. In Cologne, Duisburg and Dortmund heating gas costs $0.69, against $1.10 per 1000 cu. ft. for lighting. Generally the price varies much in different cities for various reasons. The employment of automats and the total consumption in a community being everywhere different are responsible for it. Frequently the amount taken by one user makes a difference, as a discount is granted. For lighting the lowest price is $0.90 per 1000 cu. ft. in greater Berlin. In Magdeburg, Breslau, Hamburg, Leipzig, etc., it is $1.24. In some cases $1.24 and $1.58 are charged, as, for instance, in Munich. During the last decade the price has remained the same in half of the cities; in nearly the half it has decreased, and an increase took place only in four places.

The Passing of the Lamp-Lighter

By Felix J. Koch

THE LAST OF THE LAMP-LIGHTERS

Passing from out our village life in the greater part of the United States to-day is the lamp-lighter. Hardly a town so poor to-day but has its electric light; where not, there is the device for lighting the gas lamps simultaneously. At most, a lad goes about, pulling a little chain, and raising the flame thereby.

At Chevoit, in southern Ohio, however, there is still a lamp-lighter of the good old sort. Mounted on his gig, the man has his seat between two long cases, containing receptacles for oil. As the horse criss-crosses the street, from lamp to lamp, he stops at each, takes out the empty canister, puts in a full one, then a stroke of the match, and he is off. Next day he is back to repeat the performance. There are not many left of these old-time lamp-lighters. Time will come, doubtless, when tales of their work will smack of very ancient history.

Practical Problems in Illuminating Engineering

Some Illuminating Engineering Data

By J. S. Codman.

Illuminating engineering as a science is still very young, and the need of definite data obtained from actual lighting installations is very great. The writer has, therefore, thought it well to present to the readers of the "Illuminating Engineer" certain data obtained from tests in the large clothing store of Leopold, Morse & Co., Boston, the lighting of which was recently completely revised in accordance with his directions. As a result of this revision 68 arc lamps were replaced by 185 100-watt tungsten lamps equipped with prismatic reflectors, and the saving in current consumption in the different rooms ran from 34 to 62 per cent. The latter saving was made in the rear room on the second floor, and it was in this room that the tests were made.

The tests consisted in measuring the watt consumption of the lamps, and the average illumination on the plane of the counters, first with the original arc installation and then with the new installation of tungsten lamps. From these tests were obtained the results given in the following table:

TABLE I.

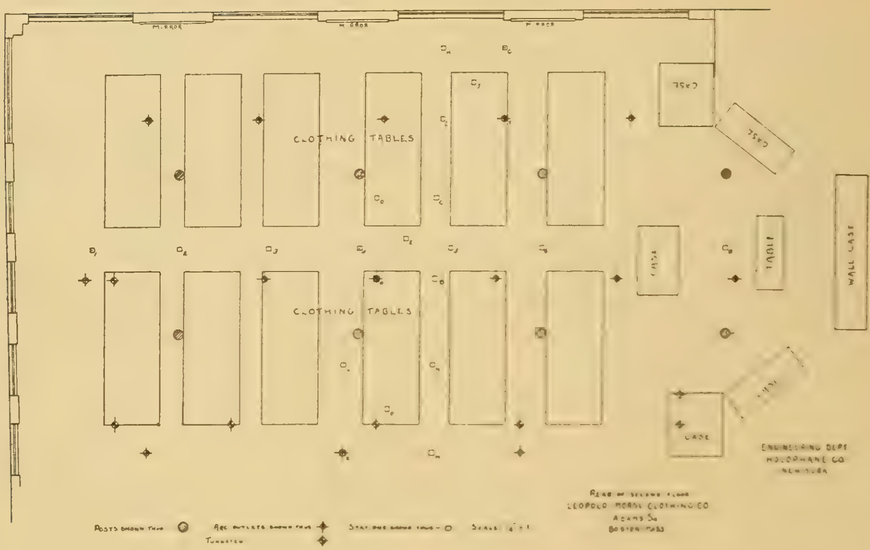
	Number of lamps.	Total watts.	Average watts per lamp.	Average illumination on test plane.
Arc lamps	15	7,950	530	4.0
Tungsten lamps	32	3,017	94.3	4.6

The above table gives the final results, but there follows data in regard to the new and old installations, including a plan of the room, and a description is also given of the tests.

The original installation consisted of 15 4¾-ampere multiple arc lamps, equipped with clear inner and opal outer globes, arranged as shown on plan, and hung so

TABLE II.

	Arcs.				Tungsten.				
Station.	Mean foot-candles.	Max. deviation from mean.	Average deviation from mean.	Per cent average deviation from mean.	Mean foot-candles.	Maximum deviation from mean.	Average deviation from mean.	Per cent. average deviation from mean.	Calculated foot-candles.
a	8.31	2.09	0.94	11.3	8.27	0.27	0.11	1.3	5.7
b	6.20	1.00	0.42	6.8	5.05	0.25	0.13	2.6	4.5
c	3.62	0.38	0.14	3.9	2.72	0.12	0.06	2.2	1.9
e	5.44	0.76	0.43	7.9	4.10	0.10	0.07	1.7	3.5
d	3.92	0.12	0.08	2.0	3.15	0.25	0.13	4.2	2.4
f	5.46	1.94	0.49	9.0	9.85	0.45	0.24	2.4	5.4
g	2.35	0.15	0.10	4.3	2.42	0.08	0.03	1.3	1.7
h	2.34	0.26	0.09	3.8	2.03	0.07	0.04	2.0	1.2
j	3.89	0.51	0.32	8.2	4.65	0.15	0.10	2.1	3.2
i	3.87	0.47	0.16	4.3	4.35	0.15	0.12	2.7	3.4
k	3.97	0.63	0.32	8.1	2.80	0.00	0.00	0.0	3.1
m	2.08	0.28	0.09	4.3	4.03	0.23	0.11	2.7	1.7
n	2.50	0.20	0.13	5.2	3.30	0.20	0.10	3.0	2.1
o	2.22	0.22	0.15	7.1	7.94	0.34	0.11	1.4	5.6
1	2.75	0.15	0.07	2.5	2.82	0.12	0.08	3.8	2.4
1	3.02	0.38	0.18	6.0	3.94	0.16	0.08	2.1	3.8
2	2.35	0.05	0.05	2.1	2.55	0.15	0.08	3.2	1.9
3	3.49	0.11	0.05	1.4	5.69	0.29	0.18	3.2	4.9
4	4.85	0.35	0.17	3.5	5.77	0.17	0.08	1.4	5.1
5	6.27	1.03	0.18	2.9	4.62	0.12	0.08	1.7	3.3
6	3.44	0.16	0.08	2.3	3.84	0.16	0.06	1.6	3.2
7	No reading.				No reading.				
8	4.55	0.45	0.18	4.0	9.60	0.60	0.30	3.1	4.3



PLAN OF STORE

that the arc was 9 ft. 8½ in. from the floor. A measurement of the total consumption by means of an ammeter and voltmeter showed a consumption of 7950 watts, or an average of 530 watts per lamp.

The new installation consists of 16 two-light fixtures, arranged as shown, each fixture carrying two 100-watt tip frosted tungsten lamps, lamp centers being 10 ft. 6 in. above the floor. Each lamp was equipped with a clear prismatic reflector No. 6061 and Form H holder. A measurement of the consumption showed 3017 watts or 94.3 watts per lamp.

The illumination tests were made with a Sharp-Miller photometer by the writer and Mr. E. B. Rowe. Readings were taken at 22 test stations as shown on plan, first for the arc and then for the tungsten lamps, and results obtained are given in the following table. At nearly all the stations three readings were made for each installation by each observer, but on account of the unsteady light of the arc lamps it was found necessary with the arc installation to take, at a few stations, a greater number of readings. At stations a and b nine readings were taken by each observer and at stations c, f and i six readings by each observer.

The average illumination on the test plane for the two installations was figured in two ways. The first method was to find the mean of the values at stations A to O, inclusive, which stations had been so chosen that it was thought that this mean would be a close approximation to the average value over a certain area of the plane, which area would include the 12 large tables, the spaces between them and a moderately wide margin surrounding them. Calculated in this way the average illumination by the arc lamps was 3.9 ft. candles, and by the tungsten lamps 4.5 ft. candles.

Another method of calculating the average illumination was to find the mean of stations 1 to 8 representing the longitudinal illumination of the room and to find the mean of this value and a value for the transverse illumination. The latter value was taken as the mean of stations m, n, b, c, i and h, being a transverse line midway between outlets; and of stations k, l, a, d, f and g, being a transverse line approximately on the line of outlets. This method gave 4 ft. candles for the arcs and 4.7 ft. candles for the tungsten. The values given in Table I are the mean of the values obtained by the two methods and are of use in comparing the illumination from the two installations. The writer does not consider, however, that these values, namely, 4 and 4.6 ft. candles, respectively, for the arc and tungsten in-

stallations, can be used in order to find the lumens effective on the plane per watt, for the reason that these average foot candle values cannot be considered to cover the whole area of the test plane included by the room; while on the other hand the watts expended are utilized for illuminating the whole area. Assuming, however, for the moment that we consider the values to apply to the whole area of the test plane, that is to about 3900 sq. ft., we find that the lumens effective on the plane are 15,600 for the arc lamps and 17,900 for the tungsten; and the lumens per watt 1.96 for the arcs and 5.9 for the tungsten. These values are too high, but it is nevertheless interesting to compare them with the general values quoted by Messrs. Cravath and Lansingh, namely, two lumens per watt with 5-ampere arc lamps with clear inner and opal outer globes; and five lumens per watt for light walls and 4 lumens per watt for dark walls with tungsten lamps and clear prismatic reflectors. Considering that the walls of the room in question were hardly what could be called "light," although they were not very dark, the results obtained would seem to show that Messrs. Cravath and Lansingh's figures for tungsten lamps and prismatic reflectors are conservative, but that they have somewhat overrated the illuminating value of the arc lamp.

In the last column of Table II is given the illumination in foot candles at the different stations as calculated from the photometric curve of tungsten lamp and reflector. If these values are averaged in the same manner as the measured values, the result 3.4 foot candles is the corresponding average value of illumination. This figure should be taken at a little lower value, probably 3.2 foot candles, in order to compare it with the measured value of 4.6 for the reason that the tungsetn lamps did not operate with rated wattage. The comparison shows that the reflection of walls, ceiling, &c., added about 44 per cent. to the effective illumination.

It is also interesting to note that if all the lumens generated by the tungsten lamps, that is about 24,000, were effective on the plane of illumination, the average illumination would be about 6.2 foot candles. This is the maximum value theoretically possible, and the actual value obtained, viz., 4.6 foot candles, is therefore about 74 per cent. of the theoretical maximum, and the calculated value of 3.2 foot candles, which supposedly represents the actual value with reflection from walls, ceiling, &c., eliminated, is 52 per cent. of the theoretical maximum.

Industrial Lighting With Inverted Gas Burners

By F. G. Corbus

The photographs reproduced on the following page illustrate the inspection department of a large collar and cuff factory. The first illustration shows the room as previously lighted with upright mantle burners and metal shades. The effect on the eyes of these glaring lights placed almost in the direct line of vision, and in such a manner that it is impossible for the eyes of the workers to escape them, is enough to make one shudder.

The second illustration shows the same room with a modern installation of inverted burners arranged by an illuminating engineer. The bowl reflectors and presumably frosted inner globes protect the eyes entirely from the direct glare of the mantles, while the distribution of illumination is so even as to furnish an almost ideal light for working.

The proprietors themselves say of this installation that "it is far superior to any system of lighting heretofore used. This appears to be due to the fact that the light is evenly distributed over the entire table, and, in fact, throughout the room. This even distribution enables the operatives to work without strain on the eye, and to sit or stand in a natural, easy position. The result is more and better work. The improvement is most noticeable in our examining room, where collars are given a final, rigid examination for defects in workmanship, laundry and color."

There is no manufacturer to-day who would not be glad to increase the efficiency of his workmen and the quality of his product by the use of better artificial light, if he could be absolutely sure of securing such improvement.

GAS ILLUMINATION IN A COLLAR AND CUFF FACTORY

SAME FACTORY LIGHTED BY INVERTED GAS BURNERS INSTALLED ON ILLUMINATING ENGINEERING PRINCIPLES

Fixtures and Accessories

Commercial Fixtures

By commercial fixtures we mean those used in commercial buildings. The lines for this classification may be pretty clearly drawn; commercial buildings include manufacturing plants of all descriptions, office buildings, stores, most public buildings, and certain portions of hotels, restaurants, &c. This class of buildings comprise probably 90 per cent. of the field of illuminating engineering as applied to interior lighting.

The objects to be attained, in the order of their importance, are: Quality, *i. e.*, adaptability of illumination to the purposes required; efficiency and decorative appearance.

The classification of a building as commercial indicates that it is devoted to activities having financial gain as their ultimate object, that it is merely a part of the machinery concerned in the production and distribution of the products of labor. Wherever human labor enters into an economical problem it holds first place in importance, hence the first consideration in the illumination of this class of buildings is to furnish such a light as will enable every individual worker to pursue his special duties to the fullest extent so far as the results depend upon the use of vision. There is no greater piece of extravagance than requiring even the cheapest grade of labor to work under poor light. Compared with the cost of a laborer's time, the cost of the best possible light which can be provided is a mere trifle. The best, moreover, does not mean simply the brightest, but includes considerations of direction, color, diffusion—in fact, all of the elements which affect the sense of vision.

A lighting fixture may be considered as a mechanical device for supporting a light source with its accessories for distributing and diffusing the rays. Putting the two definitions together it follows that a commercial lighting fixture is an apparatus which will produce from a given light source the best possible illumination for the carrying on of human labor.

Next to securing the proper quality of illumination, efficiency is to be considered. This includes cost of installation and cost of maintenance. The first of these items is determined, to a certain extent, by the third point for consideration, namely, the decorative effect. This may amount to practically zero in the case of certain classes of factory use, to a factor of considerable influence in installations having to do with the higher grades of labor and the general public, such as fine office buildings and stores. Both of these types of buildings are vastly different to-day from what was considered sufficient a generation or two ago. This difference is well illustrated in an incident related by a Philadelphia merchant who had fitted up a particularly elegant store, in which fine groceries, confectionery and a restaurant were included. Before the store was occupied it was visited by a Frenchman, who after looking it over with unfeigned admiration, expressed his conclusions thus: "In America you call this a store; in France we would call it a palace." Without exaggeration it may be said that many of the modern stores in American cities would make some of the famous palaces of the Old World seem mere workmen's cottages by comparison. Likewise, the modern office building is no longer a sort of civil barracks, in which merely the physical necessities for clerical labor are provided, but is a combination of convenience and elegance. To a very consider-

FIG. 1

able extent, therefore, the appearance of commercial fixtures is a serious item; nevertheless, the commercial element is always dominant, and the decorative element of the lighting fixtures will always be subordinate to efficiency and effectiveness in results.

The dress of a lighting fixture in a store, for example, may be compared to the dress of the sales people. One would expect to see a saleswoman neither in a calico dress and gingham apron, nor a reception gown and jewels. Neatness, a reasonable conformity to the prevailing fashions, material neither cheap nor gaudy, and an evident adaptability to the work of the wearer, would go to make up the costume one would expect to find in a well ordered establishment. These principles will apply to lighting fixtures with but little variation. The fixture made of

FIG. 2

FIG. 3

plain gas pipe or brass tubing, or the commercial arc lamp with its hopelessly plain casing, are as out of place in a store or commercial building that is frequented by the general public as would an elaborate chandelier bedecked with accessories of an essentially decorative character.

It is hardly necessary to reiterate the charges that have been so frequently made against office and other public buildings as to the incongruous and defective fixture installations that are so often found.

FIG. 4

Examples of this kind are so numerous as to render any special designation unnecessary. On the other hand, in the attempt to get away from the ugliness and commonplace that has characterized fixture installation so frequently in the past, the other extreme is not infrequently met with, namely, the use of fixtures which are unsuitable from the decorative standpoint by reason of their evident contravention of "the eternal fitness of things."

From the first requisite of a commercial fixture it follows that the most efficient and improved types of light sources must

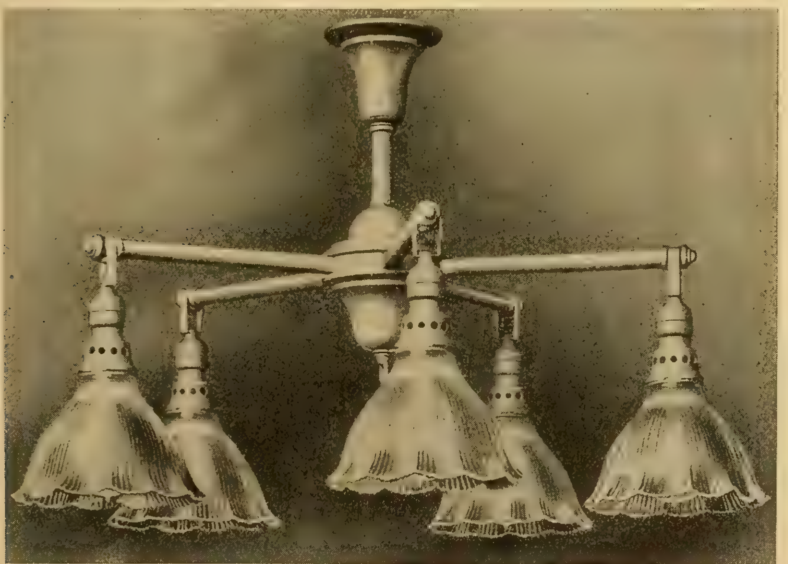


FIG. 5

FIG. 6

be used. Just at the present time these include the tungsten lamp, the Nernst lamp, the flaming arc and the mercury vapor lamp when electricity is the luminant, and both the inverted and upright type of mantle burners when gas is the luminant. Among the electric lamps, the flaming arc and mercury vapor types are generally units in themselves, and therefore do not come strictly within the meaning of lighting fixtures.

The tungsten lamp has two characteris-

FIG. 7

tics which influence the construction of a fixture: the necessity of being operated in a vertical position, and large total light power. These qualities are sufficient to cause rather radical changes in fixture construction. Thus, a six-arm chandelier, equipped with 32 candle power lamps, which is the highest candle power practical in the carbon filament type, gives a total of only 192 candle power, while a two-arm fixture, equipped with medium sized tungsten lamps, produces a somewhat larger volume of light, and a six-arm fixture equipped with the highest candle power, produces 600 candle power, or practically over three times as much.

The tungsten lamp also possesses certain characteristics which influence materially the design of the accessories. It has an extremely high intrinsic brilliancy, which increases proportionately the necessity for some means of diffusion, and it

FIG. 8

has a very wide distribution curve, *i. e.*, gives its strongest light at the horizontal, which requires a reflector of some sort to deflect the rays into the most useful directions.

A fixture for tungsten lamps therefore has sufficient points of difference to justify its being classed as a distinct illuminating unit. Several characteristic designs of such fixtures are shown in the accompanying illustrations. Since the tungsten lamp is not only available, but probably most successful in the high-power units, single light fixtures are of corresponding importance, and have taken the place to a considerable extent of cluster fixtures using the old type 16 c. p. carbon filament lamp.

Fig. 1 shows an attractive design of

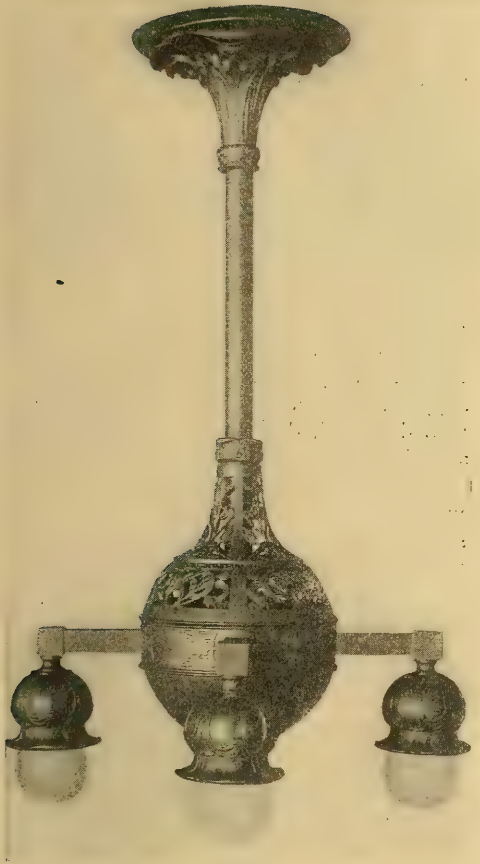


FIG. 9

Fig. 1. A study of the mechanical and artistic elements of this fixture will show that it embodies the principles which we have already set forth as to appropriateness to the purpose for which it is intended.

Fig. 5 shows practically the same construction with the substitution of round elements for the square. A remarkable feature of these particular fixtures not shown in the illustration is that they are so constructed as to actually fold up like an umbrella; this is illustrated in Fig. 6. To be able to purchase a chandelier in a box, take it to your office or store, unfold it like an umbrella or music stand, and put it in place with no more effort or skill than is required for the musician to set up his rack, is certainly an exhibition of modern American ingenuity that has few parallels.

Figs. 7 and 8 show designs for four-light chandeliers for use with tungsten lamps, which embody the same grace of outline and pleasing simplicity as the single light fixture in Fig. 3. The lamps can be placed at any height by simply lengthening the central support.

The recent special fixtures constructed for use with the Nernst lamp have been

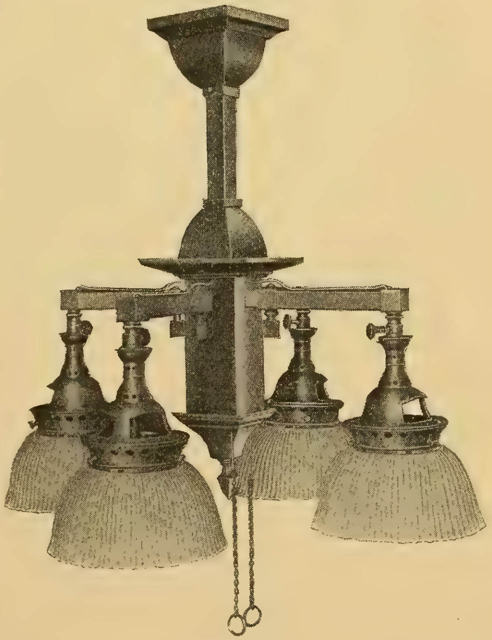


FIG. 10

this kind, the square construction giving relief from the general effect of the old, familiar round canopy and tube, while the hook support for the lamp and shade not only insures the latter hanging vertically, but suggests to the eye a certain flexibility which relieves the stiff mechanical appearances of the continuous tube support.

Fig. 2 is an exceptionally graceful design for a single fixture, the lines of the canopy, husk holder and reflector harmonizing so as to form a single unit of the entire fixture.

Fig. 3 illustrates the same fixture lengthened by the use of a chain support. This construction not only admits of ready adjustment for height, but also removes the stiffness of the single tube.

Fig. 4 shows a four-light chandelier constructed on the same general lines as

FIG. 11

already described and illustrated (November, 1908, issue, page 521). By way of more ready comparison, however, a characteristic design is shown in Fig. 9. In this fixture only the lighting elements of the lamp are placed within the globes, while the electro-mechanical elements are contained in the central body. This results in simplicity of construction, so far as practical use is concerned, as well as highly artistic design. The fixture was aptly described in the article referred to "as absolutely unique among lighting devices."

The tungsten lamp has its counterpart in the gas field in the inverted burner. The total volume of light from the latter is about that of the average tungsten lamp, and the quality of illumination also practically the same, the lamp likewise being used in a vertical position. The conditions therefore for constructing a fixture for this light source are substantially the same as those of the tungsten lamp, and as might be expected, a great deal of similarity results.

Fig. 10 illustrates a chandelier designed to support four inverted burners, each equipped with a by-pass, and double chains provided for lighting and extinguishing the burners. The separate gas supply pipes for the by-pass will be seen on top of the arms of the fixture, but when such a fixture is installed at its usual height these would hardly be visible.

Fig. 11 shows a combination of the inverted gas burner with the tungsten lamp, by-pass and chains being used as in Fig. 10.

Fig. 12 illustrates the latest design of Nernst Lamp unit. The square canopy, support, and central body is exceptionally well designed, the ornamentation showing a high degree of artistic refinement.

Improved light sources and the interest which they have aroused in the general subject of light have undoubtedly tended toward more appropriate, and therefore more truly artistic fixtures for commercial use. Improvement in science is inevitably followed by improvement in art, at least in the use of art in connection with utility.

FIG. 12

Theory and Technology

Plain Talks on Illuminating Engineering

By E. L. Elliott

XIX. EXTERIOR LIGHTING:

General Considerations.

Illuminating engineering as a science and profession had its origin in a demand for better practice in interior lighting. From the fact that methods of utilizing the light of modern sources for purposes of interior illumination were ridiculously illogical, and not only wasteful in point of cost, but often unsatisfactory in results to the point of absolute danger to the eyes, it naturally followed that the first years in the development of the new science were devoted to the study and correction, so far as possible, of these inefficient and faulty methods. While the fact was recognized that the science includes every phase of artificial illumination, the question of exterior lighting was less pressing in its demands for attention, for the reason that close eye work is never done under such light, and for the further reason that the importance of exterior lighting in the pursuits of business is less conspicuous than in the case of interior lighting.

That public lighting is not simply a commercial utility, to be considered only as an adjunct of labor, has been gaining rapid recognition during the past year. There has been an awakening to the very patent fact that the average street illumination in this country is woefully inadequate, either by comparison with the average interior illumination, or with modern city equipment in other utilities. This realization of the importance of treating street lighting as an expression of public spirit, as well as a simple utility, has come so quickly and so impressively, that in many cases the demand for reform has been impatient of the time and energy required to educate the majority of voters up to such a state of appreciation that they would expend the public monies for the purpose, and the installation, and even in some cases the maintenance of better systems, has been due to private funds. In this direction we believe lies the most active and important field for illuminating engineering at the present time.

We called attention several times in the early issues of this magazine to the advisability, if not the absolute necessity, for economic and other reasons, of an illuminating engineer being included among the list of city officials. The demand for such action is far greater at the present time than at any previous period.

It is the purpose of this, and the succeeding discussions of the subject, to point out such of the most important conditions and facts as will enable the layman who may be interested in the subject to form an intelligent judgment of the results of any given installation, and the relative merits of the principal systems now available. In seeking to accomplish this it is probable that the explanations and statements that have already been made may be reiterated; but it is safer to repeat than to omit.

Street lighting is divisible into two pretty distinct classes, which may be termed " street illumination " and " beacon lighting." In the former are included all cases where the pavement is plainly

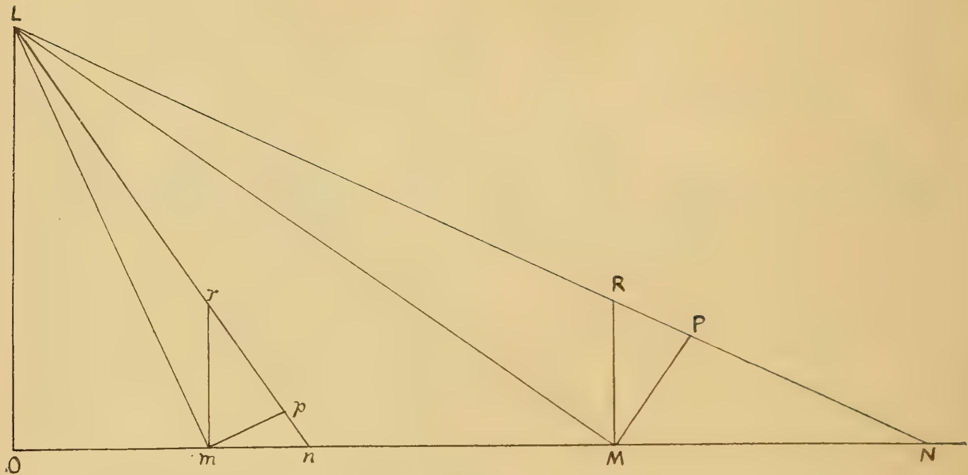


FIG. I

visible between adjacent light-sources; in the latter, those cases in which no attempt is made to render the pavement clearly visible for the entire space between the light-sources, the light-sources serving as beacons to show the direction of the street, in a manner somewhat analogous to the use of light-houses to point out waterways.

The question may be rightfully asked: What is the exact dividing line between these two classes? The suggestion has been made, from what original source we cannot recollect, that a street may be considered illuminated when it is possible to read the time on the face of an ordinary size watch having black symbols on a white ground. The average eye can readily do this with an illumination of .01 foot-candle intensity. This test has the virtue of being eminently practical, and when the need arises for mathematical accuracy, as, for instance, in the wording of a contract, the intensity given may be taken as distinguishing between the two classes of illumination. Where the time can be read on the face of a watch, the print on a visiting or business card, and ordinarily legible writing can also be read. Reading the street address, on the time, concludes all the necessities of close vision in exterior lighting. Intensity of this amount will also render all obstructions that can be of any possible harm plainly visible; in other words, a carriage or automobile could run at full speed through a street lighted with this intensity without the use of head-lights.

The next question that naturally arises in the technical consideration of the matter is one that has been often discussed—namely, the manner in which the measurements of illumination should be taken, whether on the horizontal, vertical, or normal, and whether on the pavement itself or at some point above. There are arguments for and against each of these methods. While these have been previously given, it will not be amiss to repeat.

First: horizontal illumination on the surface of the pavement.

This is based upon the theory that the pavement is a mathematical plane, *i.e.*, a perfectly smooth, flat surface; in which case its brightness as seen by the eye would depend upon the intensity of the horizontal illumination. The objections to this are, that a pavement is never an actual plane, but a more or less uneven and rough surface; and, also, that it is difficult to make measurements on the surface of the street. Until recently, in fact, such measurements were practically impossible; but the introduction of the Sharp-Millar illuminometer, has entirely removed this difficulty.

Second: vertical illumination, either at the level of the pavement, or some point above not higher than the average level of the eyes.

The argument in favor of this is, that the visibility of objects in the street, such

as unevenness, obstructions on the pavement, or other vehicles and pedestrians, which are the objects that it is necessary to see, depends upon the perpendicular illumination rather than by horizontal. Furthermore, it is a simple matter to measure perpendicular illumination at any ordinary height. The only objection to this method seriously offered is that such a measurement only takes into account the light from one direction.

Third: normal illumination, *i.e.*, illumination on a surface perpendicular to the rays of light.

In favor of this measurement it is argued that when we wish to see any object at close range, such as an address card, or the face of a watch, we naturally hold it so that it will receive the maximum illumination, which is of course secured when the surface is perpendicular to the most intense rays of light. Furthermore, that obstructions and other objects in the street are rendered visible to a greater extent by normal rays than any others. The only arguments against this method is the one offered against vertical measurement, *i.e.*, that it considers light from only one direction; and that there are at least theoretical difficulties in the way of determining what the normal direction is. Opposed to these there is the very considerable advantage, when it comes to making measurements, that the normal illumination is always the brightest; and as very low intensities have to be measured in many cases, it is well in taking measurements to use the maximum rather than the minimum illumination.

The expressions "horizontal, vertical, and normal intensity," are strictly technical, and it may be well to consider carefully just what they mean. The diagram, Fig. 1, may help to make the matter clear. ON may be taken as representing the surface of the pavement, and L a light-source placed at any required distance above it. Let us consider, then, the light from this source falling within the angle included between *n* and *m*,—from 25 to 35 degrees from the vertical. The light within this angle covers a distance on the pavement from *m* to *n;* if the surface were placed upright, at *m,* this same amount of light would cover a distance from *m* to *r;* while if a surface were placed vertical to the ray L*m,* it would cover the space from *m* to *p*. It will be seen at once that the smallest amount of space covered by the light will be on a surface perpendicular to the rays; and since the smaller the space covered by a given quantity of light, the higher will be the intensity of illumination, it follows that the illumination on this perpendicular plane, or as it is commonly called, "normal illumination," will be stronger than that on either the vertical or horizontal planes.

Again receding from the point directly underneath the light-source, let us consider the light falling on the pavement within the angle from 25 to 35 degrees below the horizontal. The distance on the pavement now covered by the same quantity of light is from M to N; on a vertical plane, it would extend from M to R; and on a normal plane, from N to P. As in the previous case, the normal plane is the smallest, and such, in fact, will always be the case. The diagram clearly brings out the fact also that, as we recede from the point directly underneath the light-source the amount of space on the pavement which a given beam of light covers increases, and if we were to follow it mathematically we should find that the farther we recede the more rapidly this horizontal distance covered by a given amount of light increases, and also that the horizontal distance becomes proportionately greater than either the vertical or the normal distance. Thus in the diagram, MN in proportion to MP is much greater than *mn* to *mp,* which means that normal illumination decreases at a much less rapid rate with distance than horizontal illumination.

Careful analysis of the three methods would seem to give a preference to the last one mentioned. The first one obviously depends upon pure theory, and therefore represents a condition which never exists in practice. As to the question of measuring the light only from one direction, this accords entirely with the actual facts in regard to vision, so far as all kinds of obstructions are concerned. This would apply to all slow-moving vehicles and to pedestrians.

Illuminating Engineering in England

As noted elsewhere in this issue, the agitation which has been carried on for the past three years, under the leadership of Mr. Leon Gaster, for the establishment of an illuminating engineering society in England has at last resulted in definite action. The policy followed in this country in establishing the society on the broad basis of illuminating engineering, rather than a society of illuminating engineers, has been followed in England also.

So far as visible evidences are a guide, the progress of the movement to establish illuminating engineering as a profession in England has been making satisfactory progress. A year ago a monthly magazine, having the title, the *Illuminating Engineer,* was established under Mr. Gaster's editorship, assisted by Mr. J. S. Dow. The high professional standing of the special contributors, and the frequent quotations from its editorial columns as well as from its contributions, by the technical press of the world, are distinct proofs that, scientifically at least, the magazine has been a full success. Mr. Gaster is also delivering a course of four lectures on illuminating engineering subjects before the Royal Society of Arts. Two of these have already been delivered, the first dealing with electric light-sources, and the second with gas light-sources.

The London electrical and gas journals take the matter much more seriously than when it was first proposed. The *Electrical Engineer* gives its unqualified endorsement to the establishment of illuminating engineering. The *Gas World* shows a very much more tolerant attitude than it assumed three years ago when the idea was first proposed; its only serious doubt now seems to be whether the gas and electric lighting interests, between which there is such keen rivalry in England, can be harmonized.

It is to be expected that matters will move a little slower in England than in America, but that the recognition of illuminating engineering will be eventually as complete and enthusiastic there as it has been in America there is little room for doubt. The fact should not be lost sight of in making any comparisons that, though the name did not exist, the first work along scientific illuminating engineering lines was largely done by Englishmen. Many of the principles and ideas that were later rediscovered and put forth as new in America can be found fully described in English publications dating back nearly a half a century.

To the English Illuminating Engineering Society we, therefore, repeat most heartily the toast of Rip Van Winkle: "*May you live long and prosper.*"

Selling Light

We have frequently called attention to the peculiar fact that, while illumination is one of the most valuable of commodities in civilized commerce, it has practically never been bought and sold as such, and have also pointed out that with the present means of measuring light it would be entirely feasible to reckon its commercial value upon the measurement of the thing itself. The National Electric Light Association practically endorsed this method of procedure at its convention two years ago; and now there comes the cheering

word from an Eastern central station that a system of selling light in candle-power hours is being inaugurated among its private customers.

In the early days of the electric light, when its photometric rating was determined by hanging up a row of lamps, turning on the current, and picking out those that had about the same color, a rough method of selling light was more or less practiced, which consisted in charging by "lamp hours," *i.e.*, the number of hours that a given lamp burned. This was convenient to the central station for the reason that electric meters were then even less reliable than the lamps. Later, with the development of the electric meter, it served the interests of the central station to sell electric current rather than electric light. The meter could be locked up, and was not subject to the moral risk incident to keeping tab on the use of lamps.

This method would have continued to prevail, to the satisfaction of the producer of current, had it not been for that always troublesome and erratic factor—progress. After the carbon filament lamp had run along in the even tenor of its way for a quarter of a century, and the electric meter had bred sufficient contempt through familiarity to assure its being practically overlooked and forgotten, the unexpected happened; the habits which the producers of electric current had been fixing upon the minds of users with so much confident satisfaction were seen to be full of danger. New electric lamps appeared which only took one-third as much current as the old carbon lamp; and since the central station was selling current it was a simple matter for the user of light to reduce his bill by that amount, and thus secure to himself the entire advantage of this remarkable improvement.

What was to be done? The first impulse was to befog the customer with a new commercial rating of the lamp, which, though having some scientific significance, should be entirely meaningless to the layman. The lamps were rated in "watts" instead of in "candle-power," a subterfuge which may be likened to the shallow trick of the medical profession in writing out the names of the most commonplace drugs in bogus Latin. Even though the user may fail to distinguish between a watt and a candle-power in print, he has no trouble in distinguishing between the amount of light given by a tungsten lamp and a carbon lamp running on the same amount of current. Furthermore, the user of light has been gradually learning that it is a very important item in his daily life, and well worth his knowing something about; and information on the subject in plain language has become increasingly plentiful within the past few years, and is likely to increase in the immediate future.

In the field of arc lighting substantially the same conditions have prevailed. It is not strange, therefore, that there should be a tendency to fall back upon the old plan of selling light, instead of electric current. By this method a reasonable division of the advantages of the improvement in electric light-sources may be secured between consumer and producer. The consumer, knowing exactly what he is paying for, will, moreover, have less tendency toward pernicious activity in inquiring into the forms of contract, meter readings and other mysteries of the kind.

On the whole, the sooner a method can be worked out of placing the money value of electric light upon the basis of the light produced, the better it will be for both producer and consumer.

Small vs. Large Lighting Units

The arc lamp was the first form of electric light to be made commercially practical, and it was at once recognized that one of its most serious faults was its very excess of light-power. The fact was clear that if electric lighting was to become generally available, smaller units must be devised. This is evidenced in Edison's first patent, which is described as "a means of sub-dividing the electric light." It was this ability to produce lamps of small candle-power that gave to the incandescent lamp such value that it revolutionized the whole practice of artificial illumination.

The tungsten lamp, which marks the second epoch in incandescent electric lighting, has encountered the same difficulty. The necessarily large quantity of

light produced has thus far restricted the use of these lamps almost entirely to commercial purposes. The trend of research and improvement has, therefore, been toward the production of smaller units. There are physical difficulties in the way of producing small units to run on the commercial circuits that prevail at the present time, and the only feasible way out seems to be a reduction of the line voltage. The announcement has recently been made of a 4 c.p. tungsten lamp, especially designed for use in signs, the voltage being reduced by a local transformer. Its practicability is thus dependent upon the use of alternating current.

The fact remains that the small unit is imperatively demanded in illuminating engineering, and if not supplied in one form it will be used in another. No matter how powerful light-sources may be devised, their field will be limited by the very fact of their high power, just as the field of the small unit will be limited by its smallness; the necessity for both kinds is absolute. There is no electrical or economical reason, however, why 8 and 16 c.p. tungsten lamps should not be furnished for domestic use in all cases where alternating current is available. The voltage can be transformed to 25 or 50 just as readily as to 110, and, in fact, will be that much the safer to use.

All attempts to restrict the use of higher efficiency lamps are of necessity artificial, and will sooner or later prove ineffectual. The tungsten lamp, or its successor, is bound to entirely supplant the carbon filament lamp; whatever changes this may make in commercial or electrical conditions may as well be anticipated, and provided for. The use of much lower voltages for a large proportion of domestic installations is a simple, practical and easy solution of the small unit problem, so far as it applies to tungsten lamps.

It is idle to talk of raising the standard of illumination for dwelling houses. No one is going to use a glaring intensity simply because they can get the light cheap. A somewhat larger quantity of light will be used, due to less care in turning off lamps when not absolutely needed, and in lighting less used rooms; but simply because light can be had at one-third the current cost is no more reason for flooding the room to the point of dazzling brilliancy than of keeping its temperature up to 100 because modern heating devices are more economical than the old fireplace.

Commercial demands have thus far exceeded the manufacturing facilities of tungsten lamps, but as the latter increases, the small unit must be evolved, and whatever other conditions may need changing must be adapted to their use.

Fixtures for Inverted Gas Burners

Now that the inverted gas light has thoroughly established itself, the question of adapting gas fixtures to the new burner may be given serious consideration. It is, of course, a simple matter to attach an inverted burner to an existing fixture by the use of a plain goose-neck; but while such a device answers all purposes of utility, it is far from satisfactory in regard to appearance. It is not so long ago that gas fixtures were common which had been transformed into electric fixtures by the simple and clumsy expedient of attaching flexible wires to the outside of the arms, and electric lamp sockets by flimsy pieces of metal clamped on to the gas outlets. All such adaptations and make-shifts proclaimed their own temporary character, and are accordingly entirely out of keeping with the idea of good construction and good design.

While the inverted gas burner is in itself no more artistic in appearance, in fact, generally less so, than the upright burner, it demands even greater attention to fixture design than the older form. Gas fixtures therefore must undergo a radical change in construction in order to conform to the new conditions.

It is a rather curious fact that, as in the case of the tungsten lamp, the inverted burner manufacturers have had to take up fixture manufacture themselves in order to secure the requisite harmony in construction and design. Having found this extraneous branch of their business profitable, it is not likely that they will abandon it. It seems strange that those engaged in the manufacture of fixtures should not have been keenly alive to the improvements in light-sources, and have antici-

pated the demands which they were sure to make upon fixture manufacture rather than to have waited to be forced into a recognition of the inevitable changes by the appearance of new competition.

It is not too late, yet, however, to get in line with the procession of progress, and those who get in promptly will secure correspondingly advantageous positions. There is a splendid opportunity at the present time for the wide-awake fixture manufacturer to secure a hold upon the trade, and a large share of new business, by studying the recent advances in the production of light, and adapting fixtures to this progress, with absolute disregard of all prejudices and ideas that have heretofore prevailed.

A Correction

In the February issue of The Illuminating Engineer we gave an amendment to an article in the previous issue in which the relative illuminating efficiencies of different light-sources were given, the amended figures referring to the Nernst lamp. We are now advised by Mr. Eustice, illuminating engineer of the Nernst Lamp Company, that through a stenographic error there was a mistake in the figures which he gave, as follows:

The value given for watts per lumen in the first test of Westinghouse Nernst lamps at the Siegel Cooper Store, Chicago, the lamps operating (dirty) under normal maintenance, should be .295 instead of .395.

Notes and Comments

St. Louis Makes Ten-Year Contract for Street Lighting

Welsbach Company Gets Gas Lighting Contract; Union Electric Light & Power Company, Electric Contract.

St. Louis has recently contracted for its street lighting for 10 years from September 1, 1910. The Sunlight Illuminating Company of Pittsburgh, whose bid was more than $157,000 less than the Welsbach Company, failed to get the gas lighting contract on account of not making certain tests and demonstrations demanded by the authorities.

The Union Electric Light & Power Company was awarded the electric contract, which aggregates $602,000 for the 10 years. Protests against letting this contract under the specifications of the Board of Public Improvements have been made by a civic league, and a committee representing the Downtown Lighting Association. The latter proposes to install a special artistic installation at its own expense in certain of the prominent business streets.

Movement for Better Street Lighting in Newark, N. J., Spreads

Two New Business Associations Present Plans for Extensions.

A special installation of street lighting by flaming arcs and festoons of incandescents on South Broad Street, Newark, was described in our last issue. This installation was a bid on the part of the merchants along this portion of Broad Street for a larger portion of public patronage. As would be expected, merchants in adjoining thoroughfares have immediately taken the cue and started campaigns for similar lighting. The progress of the movement is set forth in the *News:*

> Further advancement in the plan for the illumination of Market street, from the Pennsylvania Railroad Station to the court house, was announced to-day, following a meeting of the Finance Committee of the Market Street Business Men's Association. It was decided to submit tentative forms of contracts for the proposed new lighting plan among the business men interested.
>
> The proposed scheme for increased lighting facilities in Broad street, between Market street and Central avenue, was definitely outlined at a meeting of the Executive Committee of the Broad Street Improvement Association. It is proposed to erect 41 lights of the flaming arc type on that section of Broad street represented in the association, placing them 100 ft. apart.

Chicago Suburb Wrestles With Municipal Ownership

To Sell or Not to Sell Its Electric Lighting Plant—That Is the Question in Winnetka.

The Chicago *Record-Herald* reports the situation as follows:

Winnetka will not abandon its municipal lighting plant which the North Shore Electric Company has been seeking to purchase for $70,000. Five hundred citizens of the suburb gathered in an old fashioned town meeting last night. One hundred of them were women. Less than 10 per cent. favored the abandonment of municipal ownership and operation of the plant. Instead the meeting decided by an overwhelming vote to expend $40,000 in improving it. This was done after the reading of the report of a committee, which showed that the village could expect returns of $15,000 annually from the plant.

Opposition to this decision, however, does not seem to be satisfied that the case is lost. One of the chief objectors to the maintenance of the plant, evidently believing that it is never too late to mend, is still agitating for a rehearing, on the ground that the figures given were wrong.

St. Louis Fears That it is Going to Get too Much Light

PROPOSITION OF THE LOCAL LIGHTING COMPANY TO SUPPLY IMPROVED LAMPS IN PLACE OF THE OLDER TYPE CALLED FOR IN THE CONTRACT REFERRED TO CITY COUNSELLOR.

St. Louis seems to be hard to please in regard to its lighting proposition. The public press, and apparently a considerable body of citizens, have been in a turmoil for a couple of years over the alleged extortion of the electric lighting company. Now that the company offers to put in luminous arc lamps, giving probably twice the candle-power of those specified in the contract, the city questions the legality of this substitution, and has referred the matter to its legal advisor. The action seems to have been taken in all seriousness, without the slightest appreciation of the exquisite humor of the situation.

The *Star* says:

The Union Electric Light & Power Company has acceded to a request of the Downtown Lighting Association to substitute a metallic luminous arc lamp in the district between Fourth street, Twelfth street, Market street and Franklin avenue if the change can be made legally under the new contract, which takes effect September 1, 1910.

The Union Electric has communicated with the board on the legality of substituting a better light. City Counsellor Bates will be asked for an opinion whether the board is authorized to take more than it contracted for.

If the counsellor decides the board can do this the change will be authorized. If not the contract will be amended. It is probable, too, that the Union Electric may place the new lights all over town. In the downtown lighting district the association seeking better light has offered to give the city ornamental posts to cost in the aggregate almost $60,000.

Inverted Gas Lamps Would Save Boston $250,000 a Year in its Street Lighting, According to Consolidated Gas Co.

LAMPS OF THIS TYPE HAVE BEEN INSTALLED TO PROVE THE CLAIM.

Says the *Post:*

Experts of the Boston Consolidated Gas Company have figured out that they could save the city something like $250,000 a year on arc lighting alone by reason of the new double mantle Graetzin lamps, or German type, which have just been installed on Commonwealth avenue, as a comparison with the light that the nearby electric globes give.

Some 16 of these lamps have been placed on the avenue between Arlington and Berkeley streets, and seven single mantle Ramsdell and two double mantle Graetzins have also been put in place on Beacon street between Exeter and Fairfield streets.

The Mayor and Superintendent of Streets granted the privilege of giving the street demonstration.

Mayor Hibbard intends to visit the district where the new type of lights have been set and learn for himself just what they can accomplish.

Electric Lighting Shows Rapid Increase in Popularity in Albany

LOCAL COMPANY WILL SPEND $300,000 ON BETTERMENT OF SERVICE.

We quote from the *Journal:*

The use of electricity is increasing in Albany. The city to-day is using 10,000 of the new tungsten lamps, which is a greater number per capita than any city in the United States. Six hundred of the new lamps have lately been installed in the Union station with the result that the lighting of the building has been greatly improved.

Alexander Anderson, general manager of

the company, in speaking of the proposed improvements, said that they have become necessary on account of the steadily increasing business of the company. "From 80 to 90 private houses a month are being equipped in this city for the use of electricity," he said. "These figures do not include the extensive additions being made all the time to the equipment of business houses and factories."

Rock Island Wants More Street Lamps

AND WANTS THEM OF 2000 CANDLE-POWER, WITH HALF-INCH CARBONS.

The 2000 candle-power myth has not yet become entirely extinct. It crops up in the contract for street lighting in Rock Island, Ill., which provides that lamps must be of 2000 candle-power, operated at full candle-power, with not less than 450 watts, using carbons half-inch in diameter. The original contract containing these specifications was made in 1899; was renewed five years ago, and is made the basis for another five years' bid for street lighting. The lesson of the Colorado Springs Lighting controversy thus seems to be still unheeded. The local company, by tacitly agreeing to this traditional misrepresentation, is leaving a loop-hole open for possible legal trouble. A demand for the installation of more lamps was made by members of the Council, and the whole matter has been referred to a committee. A motion was also made looking to enforcing the ordinance for "testing gas and electric current supplied for commercial and home use."

Electric Headlights Produce Color Blindness in Locomotive Engineers

IMPORTANT EXPERIMENTS MADE BY THE GREAT NORTHERN RAILROAD IN ST. PAUL.

For legislation to regulate railroads Minnesota apparently has the lead. The latest attempt in this direction is a bill, which has already passed the Senate, requiring all railroad locomotives to be equipped with electric headlights of 1500 candle-power. Experiments conducted by the Great Northern Railroad in its St. Paul shops show the grave danger of putting such fallacies into practical operation. The experiments are thus reported by the Minneapolis *Journal:*

Railroad engineers whose sight is normally excellent were made temporary color blind last night in the Dale street shops of the Great Northern Railroad in St. Paul. The unusual condition was brought about with the powerful electric headlights with which the railroads of the State will have to equip all their engines if the Peterson bill, which has now passed the Senate, should pass the house. This bill calls for electric headlights of 1500 c.p.

Experienced engineers were stationed at the end of a track running the 500 ft. of the shops. Just in front of the engineers was one of the big electric headlights arranged to as closely as possible reproduce actual conditions on a running locomotive, even to being jolted about automatically. The men looking at the far end of the shop building, their eyes experiencing the same strain they would on a trip on a locomotive carrying one of the big lights. After some time signal lights at the far end of the track were shifted from one color to another. The men were supplied with tally cards and marked down the different signals as they saw them arranged. Frequently another of the big headlights at the far end of the track was swung directly into the eyes of the engineers to give the same effect as though a locomotive was passing in an opposite direction.

The test was in charge of Dr. J. W. Chamberlain, oculist for the railroad.

Mr. H. A. Kennedy, assistant general manager of the Great Northern, said this evening that the net result of the test was something very unexpected. Data regarding eye fatigue had been looked for, but to the surprise of those making the test, the first result was that after the operation of these brilliant headlights not one engineer was able to write down correctly the colors of switch lamps exhibited. Four colors were used, red, green, yellow and white. And 24 exhibitions were made. Not one engineer could state them all. The violet rays of the electric light absorbed the rays of the green and red lamps until the modern semaphore system was made practically of no effect. It was also stated as a result of the test that the bright lights so affected an engineer's color perception that after some continued exposure to similar conditions, he would have to be retired from service. Mr. Kennedy said he believed the test demonstrated that it would be more than unfortunate if the Peterson bill should become a law.

No More Electric Lights for Buffalo

MAYOR ADAM SAYS PRESENT NUMBER IS SUFFICIENT IF PROPERLY DISTRIBUTED.

Perhaps for the reason that shoemakers' children are proberbially barefooted, Buffalo, which is within the sound of Niagara's roar, is one of the poorest electrically lighted cities in the country; and if Mayor Adam has his way there is little prospect of immediate improvement. According to the *Times,* the Mayor sent a report to the Common Council, in response to their suggestion of placing additional lamps, in which he says: "There are now 400 more lamps in use than there were three years ago, and Welsbach lamps are everywhere. For lighting the city $300,000 a year should be ample."

Honeymooners to Be Given Great Show

$150,000 May Be Spent In Lighting Up Niagara Falls.

"Every one loves a lover." That is probably why Niagara Falls, the Mecca of all honeymooners, and no small number of "prospects" in this line, is to be lighted up by the biggest search-light ever made. The proposed illumination is thus described by the Buffalo *News:*

It is planned to illuminate the falls along the lines originally laid down by W. D'Arcy Ryan, illuminating expert of the General Electric Company. This means the expenditure of between $125,000 and $150,000 and the installation of the most power aggregation of electric projectors ever assembled. The illuminating of the falls in 1907 created world-wide interest, but the spectacle this year will far eclipse the first attempt. Rays of light of more than two billion candlepower strength will be shot upon the face of the falls and the aurora of the combined batteries will be visible as far away as Toronto. Sixty-inch projectors will be used and the spectacle will be a permanent summer feature.

"Uncle Sam" Experiments With New Street Lighting

Lamp-Posts in Center of Avenue to be Tried in Washington, D. C.

The scheme of placing lamp-posts in the center of the roadway, with benches, or isles of safety about them, which was described in a recent number of The Illuminating Engineer, is to be tried experimentally on Massachusetts Avenue, according to the *Star:*

Seventeen lamps are to be erected on Massachusetts avenue. They are to be protected by square sand boxes, forming isles of safety at their bases. The wires for supplying current to the lamps are to be run in the trees, with taps out to each lamp. Extra precautions are to be taken not to injure any tree.

If the plan proves successful, after a thorough trial, it will probably be extended to other broad streets.

Enthusiasm for Better Lighting Spreads in Philadelphia

Example Set by Walnut Street Merchants Starts the Whole City Thinking.

Starting probably from the beautiful memorial installation of lamps about its City Hall, the movement for better street lighting in Philadelphia has acquired such momentum that it bids fair to encompass the whole city and suburbs in its onward march. A portion of Walnut Street which heretofore had been just off the regular commercial center has recently been illuminated by a local merchants' association, and so successful are the results that other sections are rapidly following suit by starting similar organizations.

The agitation for better street lighting was begun at first by the *Press*—to whom be honor and glory forever—but has since been espoused by all the city papers. The movement has so many interesting and instructive features that it will be especially treated in our next issue.

Springfield, Mo., in Line for Better Lighting

Commercial Club's Committee Arranges Final Details.

The Missourian's demand to be shown does not signify his unwillingness to be convinced of a good thing when he sees it. The Commercial Club of Springfield has succeeded in securing private subscriptions to a scheme for installing an artistic lighting system on certain of its principal streets.

Correspondence

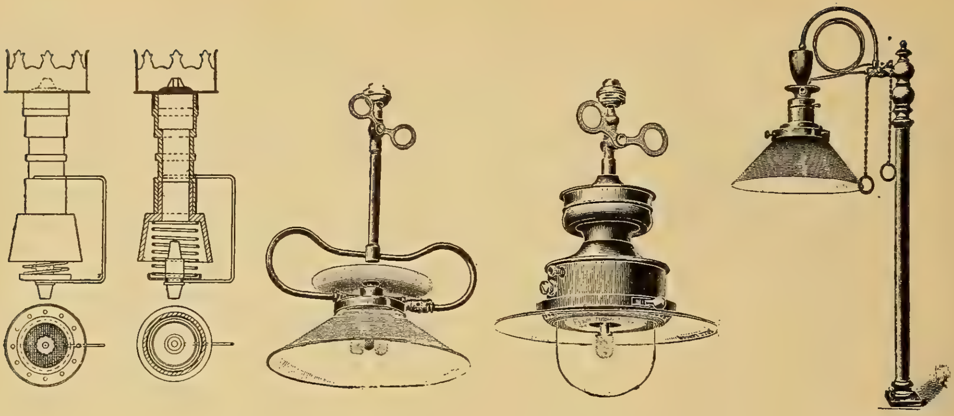
From Our London Correspondent

Notwithstanding the great advances that have been made in the toughening of the material used in the manufacture of incandescent gas mantles, there are many occasions when it is absolutely necessary to use an anti-vibrator of some sort. Mr. T. Eaves, of Bolton, has recently patented some further improvements to the invention patented by him in 1903, by which he is able to use the burner either with or without the holder for the glass chimney or with the holder only, and to easily and quickly remove it for cleaning the gauze top of the burner, and then to remove or replace them without removing other parts of the lamp; it is also claimed that the illuminating power of the gas can thereby be increased. In the illustration, Fig. 1, we show a side view, plan, vertical section and sectional plan of the burner, with the glass holder for fitting on a cove resting on a spring base.

Gas suppliers in this country are quite alive to the necessity of looking after the interests of consumers. In the old days their only thought was to "rush" them with as much gas—good, bad, or indifferent—as possible; but now they sell light, and as a consequence all gas companies of any standing provide some means of educating their consumers, and are constantly engaged in testing burners for consumption and illumination. The South Metropolitan Gas Company have the very distinct advantage of having as their chairman a gentleman, Mr. Charles Carpenter, M. Inst. C. E., a practical engineer, and a very talented photometrist. It will be remembered that he also is the inventor of the testing burner used in London by the Gas Referees, and which has been adopted as the standard London burner. Under his personal direction the company's workmen are engaged in constructing an inverted burner specially adapted for street lighting. This is undergoing the most severe tests before being put upon the market. It has, we understand, been recently subjected to severe test in competition with the latest type of metallic filament electric lamps, with such success that already orders have been received to light a large and important district.

Readers of The Illuminating Engineer will many of them be familiar with the name of Sir George Livesey, who died some few months ago after a career covering nearly 40 years, during which time he occupied the very foremost position as a gas engineer. In order to pay respect to his memory in some practical and useful manner, steps were taken to found at the Leeds University a Livesey Professorship of Gas Engineering. It was proposed to raise a fund of $48,000 (£10,000). Up to the middle of February more than $30,000 (£6500) had been received or promised, the South Metropolitan Gas Company subscribing the sum of $9600 (£2000) to the fund, as an appreciation of the life-long connection of Sir George with the company as chief engineer, and for many years, up to the day of his death, chairman. This chair of gas engineering will be primarily devoted to the training of gas engineers in the science of gas manufacture, but it is not likely that the sister science, illumination, will be overlooked. As we have said before, it is only within the last few years that gas engineers have studied illumination at all, and now there is much to learn and, we fear, few to teach.

Those on this side who have had the opportunity of studying the many excellent articles on illumination, apart from the actual question of the luminant, that



FIGS. 1 2 3 4

have appeared in your excellent magazine, are waking up to the fact that we really know very little about illumination, as such. The most enthusiastic upholder of the needs of this special knowledge has been Mr. Leon Gaster, the editor of the London ILLUMINATING ENGINEER. He has been pushing forward for months to draw together men of all ranks and professions interested in the science of illumination. The principal objection raised has been against the establishing of yet one more class of engineers; this, however, has been quite overcome by following the lead of our "American cousins," and has led to the formation of the Illuminating Engineering Society, which was formally inaugurated early in last month, when a very influential Executive Committee was nominated, and the necessary steps are now being taken to set the society at work. As we were honored by being invited to join the executive, we shall hope from time to time to be able, in our monthly letter, to keep our friends on your side of the Atlantic posted in the movements and work of the newly formed society.

As we have said before, busy minds are at work to obtain perfection in domestic gas lighting. Mr. H. W. Crow, writing to the "Gas World" quite recently, gave the following specifications for what he considers would be a perfect gas lamp:

1. Totally enclosed to protect from wind, dust and flies, and to allow the use of very small pilot flames.

2. Distance-lighted,—if possible without pilot flames.

3. Regulation of gas and air.

(a) Means for regulating gas orifice.

(b) Gas and air regulators and mixing chamber to be away from the path of the products of combustion.

(c) The device for air and gas regulation must allow of easy and delicate control.

(d) Means for securing position of air regulator, to avoid accidental alteration when dusting or handling.

(e) Air inlets to be such that they do not become diminished by the accumulation of dust. Certain fittings, admirable from the point of view of ease and delicacy of adjustment, give trouble from clogging of the narrow air-slits.

4. The nozzle to be of non-conducting and non-corrodible material.

5. Removable nipple.

6. Appearance.

(a) Artistic design.

(b) No metal work to be in the path of the products of combustion.

(c) Glassware to be of design and material to avoid breakage from uneven heating caused by damaged mantles.

7. As silent as possible.

8. Price, the lowest possible.

9. Gas consumption per candle power to be stated on each lamp under agreed standard conditions.

Surely here we have set out for us all that is needed to provide an ideal means of using gas for illumination purposes. It is true that many of the suggestions and advantages have already been secured by the makers of up-to-date burners and lamps, but our object in setting out Mr. Crow's specification is to draw attention to possibilities, with the hope of assisting those

who may be engaged in experiments and researches in the interesting work of gas-burner and lamp manufacture.

No firm in London, and we think we might say in Europe, have done more to secure perfection in gas lighting than William Sugg & Co., of Westminster. They are now turning their attention to the special applications of inverted incandescent gas burners, and have recently designed several lamps in which they are most successfully and economically used. The firm make their experiments upon a thoroughly practical scale and before offering their new inventions, light up sections of their own offices and workshops, giving each particular lamp and burner an exhaustive trial. We illustrate, Fig. 2, the Chatham, which is designed for workshop lighting. This lamp has a lift-off deflector and an easily removable shade. Another lamp, Fig. 3, the Littleton, is made in several sizes. The gas and air supply to each burner can be regulated from the outside, and the lamps are quite windproof.

Perhaps the newest form of lamp is that shown in Fig. 4, designed specially for bank desks. Here we have a special anti-vibrator. This has been found necessary owing to the vibration caused by the constant placing upon the desks of heavy books of account, ledgers, etc. The weight of the lamp, it will be noticed, is carried by the upper curved arm with spring, the burner supply tube and the by-pass being both coiled, as shown. Visiting the splendid show rooms of the Gas Light & Coke Company, we were shown, by one of the chief inspectors, these desk burners fitted up. They bear out all that is claimed for them by the makers. Books were heavily thrown upon the desks without the delicate mantles being in any way affected.

The success of the "White City," the popular name given to the Franco-British Exhibition held last year in London, doubtless reached the ears of many readers of The Illuminating Engineer. Much attention was there given to the subject of illumination, and the general effect was truly magnificent and fairy-like. Never in the history of man has such brilliant illumination been seen, at least not by those inhabiting our "tight little island." This year we are promised another grand exhibition at the same place. We have just received particulars, and illumination looms large—so large that an inspired writer in one of the popular 1 cent papers tell us that there is to be a special exhibit illustrating the history of illumination by artificial light. He says: "The exhibition will be held in a large triangular building divided into halls. The public will enter at first into a small hall dimly illuminated by the most primitive forms of artificial light. Then they will pass into bigger halls, better lighted, according to the evolution of these methods, but still gloomy compared to the rooms of the present day. Each hall will lead into a greater one, until, passing through a gradual crescendo, as it were, of illumination, the public will arrive at the largest hall, where their eyes will be dazzled and delighted by the magnificent illumination provided by the most modern and brilliant inventions."

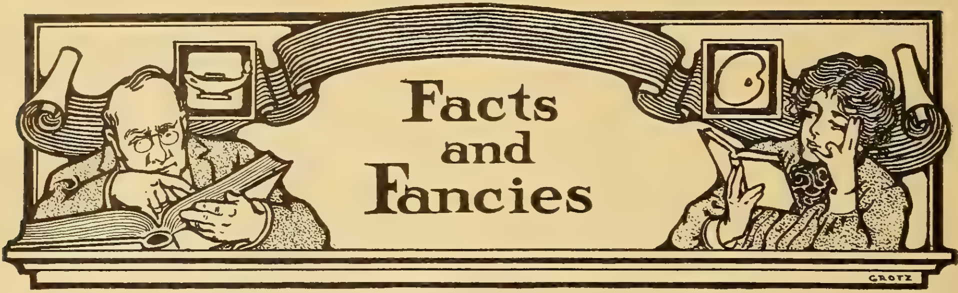
We cannot say how far the writer's statements are founded upon facts, but he has drawn a pleasing picture, and one which at least excites the interest of

Charles W. Hastings.

London, March, 1909.

How the Eyes Move in Reading

Most people think that the eyes in reading are so turned that they are directed to the letters in turn clear across the column, but if the reader's eyes are closely watched while in action, it will be seen that the eyes make a series of jumping movements, each jump corresponding to about one-half inch of letters, thus showing that the reading is done more by words than by letters, and that these words can be read without looking directly at them. In a line of printed matter, in fact, the eye fixates a number of points along the line, and from those points taken in succession it is able to read the words on that line.—*From The Optical Journal, New York.*



The Spelling Match

By Guido D. Janes

" I have a scheme," remarked Mr. Tungsten, one evening to his wife week before last.

" Put me wise."

" Well, you know since we have gotten rich quick in a watt-hour by that new arc light invention of mine, the inhabitants both of Ducktown and Friendsville want us to become philanthropists. You were raised there, I was born here. Now being a philanthropist occasionally is all right, but doing it in job lots is monotonous."

" Well, how are you going into the matter in a retail way?"

" That's just my scheme. Here it is," and rising from his installment house chair (it had now been paid for), he strolled over to where she was, and continued. " My plan is humorous, novel, full of 40 watts, electric signs and other things of a technical nature. I am going to give a spelling match——"

" How dreadfully foolish," smiled Mrs. Tungsten. " You put me in mind of a 16-candle power incandescent endeavoring to imitate a flaming arc. Your connected capacity with the educational central station is quite limited. You know, Daniel, you are not all brains."

" My dear, listen. I am going to give a free technical library to one or the other of the two towns. The one spelling the most words in a watt hour correctly will be given the said technical library."

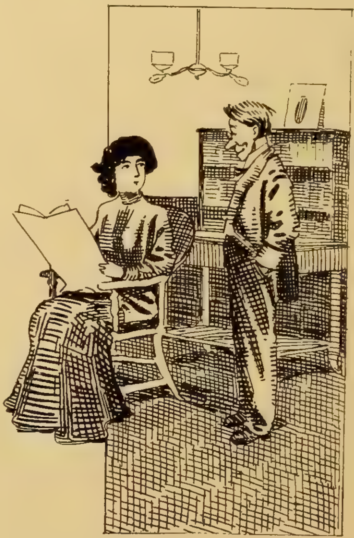
" Who are to be in the contest?"

" Those who are the proprietors of elec-tic signs. I'll give out the words here in the house over the 'phone, the merchants, &c., will receive them and get busy at once on the signs on their places of business."

" Kiss me, darling. You are a genius. The only way in which I can apologize is to let you have one. You are the 100-watt and 32-candle power light. I am the 20-watt. Your scheme is the best yet. Get busy on it at once."

" Well." Tungsten then put his hat upon his intellect, gloves on his hands and arctics upon his shoes, after doing which he strolled out upon the streets of Ducktown and informed the inhabitants of the plan he had decided upon relative to the technical library. He then 'phoned Friendsville, ten miles away, some remarks of similar purport, and smiled.

Of course both the municipalities were



WHO ARE TO BE IN THE CONTEST?

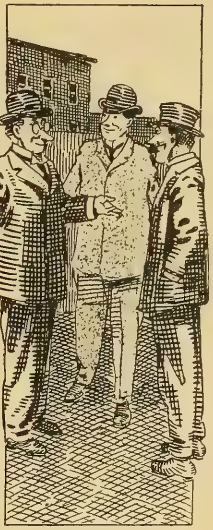
extremely tickled and hilarious over the affair. They said "Hurrah!" for Tungsten over a dozen and a half times and called him the Edison of Blount County.

Meanwhile the merchants of both places were drilling themselves on etymology, hard words, not quite so hard words, roots, derivations, and words with one syllable or over. Besides doing this they rigged up their signs with the latest improved methods such as interchangeable letter ones and one man even installed a 5-ampere watt meter.

When all was ready and after Mr. Tungsten had eaten his supper of light food and a glass of milk, he cleared his throat and strolled to the telephone located in the hall and took the receiver down. In the other hand he held the list of words.

"Are the merchants ready for the match, central?"

"Yes, you said it was to start at seven-thirty. It is within a minute of that time now."



INFORMED THE INHABITANTS OF THE PLANS

"All right. Connect up the several merchants of both the corporations. Now

FRIENDSVILLE FOLKS DID NOT

spell my name," said Mr. Tungsten a minute later.

Immediately in both towns on a hundred different electric signs the word "Tungsten" flashed forth. Ducktown spelled it wrong five times, while in the other place it was incorrect six times.

"Hurrah! Hurrah!" cried the folks of one place.

"Hurrah!" remarked those of the other.

"Spell progress." And that word lighted up the atmosphere surrounding the two towns. Both places broke even.

"Give 'em harder ones," interposed Mrs. Tungsten, who was receiving the returns over another telephone. "The inhabitants are criticising your early education."

"Is that so? Well," he remarked through the receiver, "try the word academic learning." And academic learning flashed out brilliantly. One merchant in Friendsville could not get it on his sign and he dropped out.

"Hurrah! Hurrah! Hurrah!" yelled the Ducktownites, sarcastically.

"My goodness," sighed those of Friendsville.

"Now spell Ducktown," and immediately that word jumped from darkness into light. At Friendsville a poultry merchant who had just purchased a sign and of course was in the match became so excited and mixed up that he remarked on his electric board, "Dressed, 10 cents a pound."

"Hee, haw!" humorously said one town. Tears from the other.

"Spell Friendsville now," and that word occupied the footlights for a brief time.

Now Mrs. Tungsten was from this town, so of course she was anxious for it to secure the technical library. Not being a dishonest woman she had to resort to the next best thing, and that was diplomacy. She was aware of the fact that the town in which she now resided had had electricity but a brief time, while it had become a matter of history at the other place.

Quick as a flash she left her telephone and walked over to where Mr. Tungsten was dealing out the match. "Darling," talking sweetly, "do let me give you some words. Those that you have hitherto employed are too easy for any use."

"Give me others, then."

"Tell them to spell ampere."

"Spell ampere," cried Mr. Tungsten, in a clear tone of voice.

Ampere thereupon walked into prominence over the many signs, correctly in most cases in Friendsville; incorrectly in many localities in Ducktown.

"Hurrah! hurrah!" was the expression heard in one place.

"Hang it!" was that heard in the other.

"Give them spherical candle power."

"Spherical candle power," yelled Mr. Tungsten.

Three minutes later that expression, too, jumped into electric print. As viewed in Ducktown it looked as though it had never seen the interior of a dictionary; in Friendsville it had the appearance of just stepping out of an unabridged Webster.

"Hurrah! glorious! hurrah!"

"Awful, awful!"

"Give them the word photometry now," said Mrs. Tungsten.

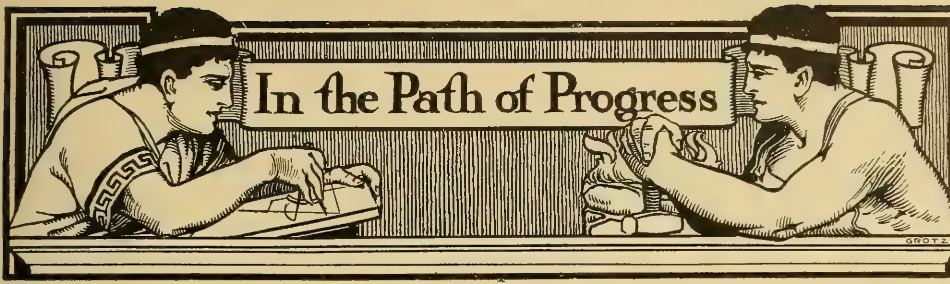
"As you wish," and this was given out.

Ducktown merchants scratched their heads. Friendsville folks did not. Ducktown hesitated, grew gloomy, and instead of tackling it, put up on their signs this: "Friendsville can have the library; we don't need it." Then they made faces in the direction of that corporation, turned off the electric current and went home.

"You win," remarked Mr. Tungsten to his wife, quite gloomily. "You got the best of me."

"How perfectly grand," and rushing over to where he was seated hugged him at least five times. "Now I have a match for you," she added. "Spell the word love."

"I can't. I will act it out, however." This he did after hanging up the receiver.



General Progress During the Past Year

In order to obtain a general review of the year's progress in the lighting field a letter of inquiry was sent to a number of representative manufacturers, central stations, and gas companies. The following replies have been received:

From Austin C. Dunham, President of The Hartford Electric Light Company.

With regard to the tungsten lamp question, we have settled on two policies here: One a policy of using indirect lighting with large tungsten units from 60 watts upward, on the general plan of the "I-Comfort" system, and we have also secured some very fine designs for reflecting lamps of a more costly and ornamental type. We think this is going to be very popular, especially with customers who occupy a position of comparative wealth, as well as with the central station, as it will take probably double the amount of current to produce the light and still make a fair bill as compared with the present cost of electric light with visible units. This has been long wanted, but we have been unable to do it on account of the cost of current. We regard this as a most important improvement in the art of illumination, as it will cut down the cost of wiring houses about one-half.

In the next place, we have decided to put out a low voltage lamp with an economy coil which admits the use of both 30-volt and 60-volt lamps. We place the meter so as to measure the loss of the economy coil, explaining to our customers that the meter will constantly be in motion, but that it is essential to the use of a 10-c.p. of the tungsten type. The economy coil rated at a 24-hr. price, which with us is 1¼ cents per kilowatt hour, makes an increase of not more than 10 per cent. for the customer, and gives the central station a 24-hr. load, which we consider quite valuable. This lamp is tough, has a very long life, and of course, almost a nominal breakage.

We find it cheaper for use than the old carbon lamp which we formerly gave away in renewals, owing to its long life, and to the fact that it does not discolor. The new Paughts process of manufacture will soon bring this lamp down to a still lower price, and this process also obliterates any chance for discoloration of the glass.

We have been able to make a meter, by changing the dial on our old induction meters, which will read candle-power hours instead of watts, and this will enable us to sell candle-power rather than watts, a thing which has been much agitated and long desired. We simply take the 25-watt lamp as a unit, and taking two and one-half watts per candle power for a 10-c.p. lamp, the control of the price is placed entirely in the hands of the central station, as they may make any price they choose per candle-power, per 100 c.p. or 400 c.p., which in that case would be a kilowatt, although nothing further would be said about kilowatts.

We consider the tungsten system now entirely complete and practical, and I believe that no lamp but the tungsten lamp will be used in the near future for small units. I have been greatly interested in this problem, and have tried to assist in developing these results.

The economy coil has a further value from the fact that the voltage can be fixed in each house so that absolutely constant

voltage can be obtained independently of the transmission line.

The tungsten lamp is very popular here, and its use is increasing at a rapid rate. We give away renewals, and treat the lamp exactly as we did the carbon lamp previously, charging the same price for the first installation that we did for carbon lamps, namely 20 cents each, and afterward giving free renewals.

We are not pushing the sign business here, as our city officials do not seem to be in favor of signs, and must acquire a taste for them by slow degrees, evidently. We, however, have a considerable display of window lighting, and some attractive sign lighting.

From E. N. Wrightington, Secretary, Boston Consolidated Gas Company

The season just ending has shown a very marked advance in the field of gas lighting in Boston, and the number of installations laid out on scientific plans has been very gratifying. The results have, in fact, exceeded the expectations in every case. As has been found throughout the country, the inverted mantle burner has filled a long-felt want, and has proved by far the most satisfactory illuminant in the lighting field, the quality of the light proving very much superior to that of any other illuminant, whether gas or electric. The question of economy has, of course, been very important, and the efficiency of the new type of lamp has enabled it to retain the great lead in this respect which gas lighting has always held.

In Boston there have been many installations of the inverted gas lamp, equipped in most cases with the prismatic distributing reflector, and hung usually in clusters of three. The resultant illumination has in all cases been signally effective, and has called forth a number of testimonial letters bearing particularly on the questions of quality and distribution. The gas company has felt that these points, rather than the marked economy of the light, are the most important factors.

The installation of upright burners and gas arcs continues at a satisfactory rate, and this form of burner will undoubtedly retain a definite field for many years to come.

There is every reason to expect that the coming year will see very important developments in the gas-lighting industry. The Boston Consolidated Gas Company has at all times been ready to give advice on illuminating engineering subjects, and during the past year has added to its ability and equipment in this line. This branch of the lighting business is sure to prove of greater importance as time goes on, as any company which is to "keep in the running" must be prepared to furnish such service to its customers.

One feature has been very noticeable, viz., the backwardness of fixture and glass manufacturers in meeting the changes in the gas situation by getting out new designs. The gas interests are frequently handicapped by the inability to procure fixtures and glassware of appropriate and artistic design, and suffer materially thereby. There is every reason to expect that the coming season will show a marked improvement in both lines, and that improvements in burners may be met by equal improvements in chandeliers, brackets and shades. There is a great field open to the manufacturer who first appreciates the importance of this situation.

From W. J. Clark, Westchester Lighting Company, Mt. Vernon, N. Y.

The year 1909 looks very promising in the new building line, the number of plans filed showing a marked increase over that of the corresponding period of last year. Our canvassers report a bright outlook for placing of appliances, and the January and February output is greatly in excess of that of 1908. During the period of depression we held our own, in fact, did considerably better than that, as we made a fairly good increase in our output.

Getting away from local matters, I would say that, in my opinion, the greatest achievement of the year 1908, in the gas lighting field, was the exhibition held in Chicago, in December, by the National Commercial Gas Association. The gas and appliance men made a most praiseworthy showing in the matter of gas illumination, and in this field the inverted lamp played an important part, and proved that it was well to the fore as a lighting factor. What I was particularly well

pleased to see, was the close affiliation of the gas man with the illuminating engineer, one of the features of the convention being a cordial exchange of courtesies between their two organizations—the Illuminating Engineering Society being the guests of the National Commercial Gas Association at its banquet, and the National Commercial Gas Association members attending in a body, the meeting of the Illuminating Engineering Society later the same evening—this is taking a long step in the right direction, and is bound to result advantageously to the gas industry.

I presume that you are aware that New York has been selected as the place for the next convention of the National Commercial Gas Association, and Madison Square Garden will be engaged for the exhibition purposes. We expect that this will be one of the great events in the gas world, and an attempt will be made to do something very handsome in the way of illumination, most likely under the direction of well-known illuminating engineers.

From Chas. E. Ummach, Secretary, R. Williamson & Co., Chicago.

We have no special news to contribute. We, as manufacturers, make up all the various kinds of fixtures, both from a scientific and a decorative standpoint, and invariably confine ourselves to the demands made on us by the dealers throughout the United States, which demands are so varied that we have found it impractical to hold our engineers to any set rule.

From N. L. Norris, General Manager, The Banner Electric Company, Youngstown, Ohio.

In running over my collection of impressions as to the lighting situation during the past year, I find them all labeled "tungsten," and as I glance into the future in this field I find that every forecast, which is now in sight, bears the one word "tungsten."

During the past year very great advances have been made in the manufacture of tungsten lamps in this country, and the sales of these lamps have increased from a few thousand per month to approximately 1,000,000 lamps per month, and still the manufacturing facilities are as yet insufficient to supply the demand.

The sale of carbon filament lamps during the past year has been reduced but slightly on account of the introduction of tungsten lamps, but the new 25-watt tungsten lamp will undoubtedly cut in on the sales of carbon lamps to quite an extent during the coming year.

I believe that 1909 will show a very decided increase in the sale of all types of lamps over 1908. While the demand for tungsten lamps will steadily increase, I do not believe that the sale of carbon lamps will drop below the sales for 1908, and that the increase in total sales will come through the increased prosperity of the country in general.

From Irvin Butterworth, Vice-President and General Manager, Detroit City Gas Company, Detroit, Mich.

We are optimists in Detroit on the subject of the future of gas lighting. During the past year gas lighting in this city has made more progress than has electric lighting. "Reflex" gas burners and inverted gas arc lamps have been installed in large numbers, and are becoming increasingly popular. They are more than able to compete, both commercially and artistically, with the improved forms of electric burners. Although many installations of the tungsten electric lamp have been made, in almost all cases they have displaced other forms of electric burners, and not gas. Gas lights about 90 per cent. of the stores in this city at the present time, and also a large majority of the residences. Our opinion is that the inverted gas arc is destined to come into very general use. A beginning has also been made here in high-pressure gas lighting, and this method constitutes a most potent means for continuing the progress and supremacy of gas lighting.

From Edwin B. Gillinder, Secretary, Gillinder & Sons, Inc., Philadeldelphia, Pa.

The factor that impresses us in considering the business of the past year, has been the intelligent interest manifested by

the general public in proper illumination. The introduction of the inverted gas lamp and the high efficiency electric lamps, together with the practical manner in which they have been exploited, has created a demand for a better type of glass.

The severity of the general stagnation of the past year has been mitigated to some extent by the introduction of both of these items.

With the public interested in the question of illumination, there should be a larger field than ever for the lamp maker and the glass manufacturer.

From Miss S. M. Sheridan, Sales Manager, The Edison Illuminating Company, Detroit, Mich.

In spite of the opprobrium heaped upon the past year we cannot complain of our growth of business. In residence lighting especially our gain in customers was very gratifying. While for several years we have had practically no competition in lighting in the *new*, high-class and medium-class residences, during the past year we find that many modest residences and cottages have installed electric lighting, and a surprising number of old houses of all classes were wired for our service. During 1908 there were more old houses wired than during any other one year of which we have a record.

In exploiting the tungsten lamp in the commercial field we have discovered an eager and expectant public. We have never before had so many unsolicited inquiries or found the users of lighting so well informed as to any form of lighting as Detroit merchants and manufacturers seem to be on the tungsten lamp. In Detroit we are meeting the demand for tungsten lighting, and in almost every instance where these lamps have replaced our arc and incandescent installations the result has been an improved standard of lighting and a comparatively small if any decrease in revenue. This lamp has also opened to us the field of the short hour burner, which because of our differential rate we formerly left unsolicited.

The flaming arc and unique lighting displays are becoming popular as advertising mediums. Up to date the moving picture theaters are doing spectacular lighting in our city.

From E. W. Lloyd, General Contract Agent, Commonwealth Edison Co., Chicago.

We have, in the past year, been able to secure tungsten lamps in sufficient quantities to distribute them to our customers, and have been fortunate in securing quite a large amount of business with this new form of lamp that we probably would not have obtained otherwise.

The growth of the use of the tungsten lamp in the past year in Chicago has been phenomenal. Almost everywhere you go you see some of them in use. At present the tendency seems to be toward the use of the larger candle-power lamps, and I think that probably this lamp will do more toward bringing up the standard of artificial illumination than anything we have had previous to this time.

We do very little street lighting in Chicago; the city owning the street lighting system, but we have installed ornamental iron posts along the curb line of several business districts, using tungsten lamps in these fixtures. These installations have proved very satisfactory in every way. The consumers seem to be much better satisfied with them than with anything that has been put out heretofore.

As to my impression regarding the new smaller unit tungsten lamp, I assume you mean the 25-watt lamp. I do not see anything but profit to a central station advocating the use of these lamps.

As to the attitude of our consumers toward the tungsten lamp, beg to say that they are making great demands on us for these lamps, and it seems as if within a comparatively short time that at least all of the larger candle-power lamps will be of the tungsten type.

From V. R. Lansingh, General Manager Holophane Company, Sales Department, New York.

Owing to the introduction of the tungsten lamp, the past year has seen a very great advance in the line of reflectors not only of the Holophane type, but also of other kinds, such as opal, mirrored, etc.

Owing to the fact that the intensity of the tungsten light is so great, it has called for the manufacture of deep reflectors sufficient to do away with the glare from

the bare filament, so that the style of reflectors has shifted during the past year very greatly. All of the new types of reflectors now made for tungsten lamps are of the deep or bowl type, and this tendency will probably be extended during the coming year.

Inasmuch as the introduction of the tungsten lamp calls for, in a large number of cases, the use of new glassware of an efficient as well as decorative type, the outlook for the coming year for reflectors fulfilling the required conditions should be extremely bright.

Joseph D. Israel, District Manager, The Philadelphia Electric Co.

It is an axiom—paradoxical as it may seem—that for a central station company to stand still, is to go back. We must progress. For a live concern there should always be a certain substantial increase in connected load. To consider at present but one feature of this load we confront ourselves with the query, What progress has been made during 1908 in electric illumination? At first glance one would be inclined to take refuge behind that overworked expression, "We were satisfied to hold our own during the general business depression of 1908." But not so with us; we must advance. With this slogan ever before us, we can now take a retrospective glance to ascertain what progress we have made.

Toward the latter part of 1907 there was a fear that there would be a marked falling off of new business in electric illumination. An analysis of the results shows that for the last four months of 1907 we had a 20 per cent. increase over the first four months of the same year in number of new contracts secured, with an increase of 34 per cent. in kilowatt equivalent. Taking the corresponding periods of 1908 we find we made a 42 per cent. increase in number of new contracts secured during the last four months as compared with the first four months of the year, with a 66 per cent. increase in kilowatt equivalent. From these facts we find, that if we concede an existing business depression in the latter part of 1907, we can see the signs of returning prosperity through the business of the latter part of 1908, which shows practically 100 per cent. as good results in the comparison with the early months of the year. The results of the early months of the year 1908 showed about 15 per cent. decrease in contracts closed but a maintenance of the same kilowatt equivalent. This was due principally to a drop in the number of contracts secured during January, 1908, on account of the general alarm of the calamity howlers which scared off the little fellows, but which did not deter the more solid concerns from the introduction of electric illumination as is proven by the maintenance of equivalent kilowatts for a less number of contracts, disclosing a high class of business. These conditions on a yearly basis show approximately the same results as to number of contracts and kilowatt equivalent covering new business of 1908 as compared with the year 1907, which latter period was considered a banner year for the electric lighting industry.

If such progress as was established in 1907 was maintained under adverse business conditions during 1908, are we not justified in congratulating ourselves upon the advance made in this public utility, and may we not safely look forward to better results during the coming year?

It is gratifying to note that this progress was not confined to any special branch of electric lighting, but was quite generally extended to both commercial and residential installations. Furthermore, with the commercial installations we noted a proportionate increase well distributed among both interior and exterior illuminations as well as spectacular and street lighting. These roseate prospects can be attributed to the education of the public for more light. The work of the magazines devoted to these principles, coupled with the achievements of the Illuminating Engineering Society, have given this propaganda an impetus which has been most satisfactory to the electric lighting companies.

As an example of what can be done by co-operative methods it might be of interest to cite a case of recent occurrence in Philadelphia. An organization looking after the welfare of the business men of a certain street in the center of the city, a little off the beaten path, realized that to make the street a thoroughfare at night it would be necessary to have good illumi-

nation. With the help of the electric lighting company, the members of the Business Men's Association were so thoroughly imbued with the necessity and feasibility of a better lighted street that in less than 60 days from the time the plan was first proposed there were placed 60 open series arc lamps along the street covering a stretch of seven city blocks, a distanct of about 3000 ft. So enthusiastic were the merchants over the success of the plan that from the time the current was first turned on these new installations there was a general celebration lasting for several days and nights. In fact, steps have been taken to make one night of each week a gala night for the display of flags, emblems, &c. The grand opening was announced by advertisements in the daily press, as follows:

"WALNUT STREET ILLUMINATED TO-NIGHT."

"Sixty brilliant arc lights, equal to 120,000 candle power, including the new lamps installed by the Walnut Street Business Association, will be turned on to-night, making Walnut street one of our most attractive and brilliantly lighted streets."

This lighting brought forth most flattering and complimentary comments from the newspapers.

That the merchants realize that "Trade follows light," we have instances of spectacular lighting in business streets located in residence districts. Two such uptown districts through their Business Men's Associations had their principal business streets especially illuminated at the time of their carnivals, carried on in the weeks immediately preceding and during the Christmas holidays.

One display leads to another, and so the bright work goes on!

The system of illumination consisted of streamers of incandescent lamps suspended in a criss cross form at the intersections of the main streets, and at regular intervals streamers were hung straight across the streets. The effect was pleasing and satisfactory to all concerned. Noticing that the brighter lights and better illuminated streets of carnival time have had a very good effect on business in general, the merchants are planning to perpetuate this feature.

In our interior commercial and residential lighting a great advance has been made possible by the advent of the tungsten lamp on account of its ready adoption by the consumers. The man who pays the bill is quick to see the merits of a lighting unit which will give him twice the amount of light for the same current consumption or the same amount of light for one-half the amount of money. When the proposition is presented to the consumer on this basis of comparison with a 20 c.p. 50-watt gem lamp there is little hesitancy on the part of the consumer in adopting the new tungsten lamp. Particularly so when his further attention is called to the fact that but a short time ago this 50-watt consumption did not give him more than 16 c.p. The tungsten lamp appeals strongly to the consumer on account of the white quality of light which it emits. The small 25-watt unit is rapidly becoming a favorite for such points where a good illumination is required for intermittent and occasional use, and where a number of lamps are desirable for lighting effects along certain defined plans of distribution.

The introduction of tungsten lamps is increasing at a rate of 20 per cent. per month, which indicates that the time is not far distant when the tungsten lamp will be looked upon as the standard unit. It will be interesting to note the comparative percentages of the number of various sizes of the tungsten lamps now in use:

25 Watt	12%	of Tungsten installations.
40 Watt	37%	of Tungsten installations.
60 Watt	26%	of Tungsten installations.
100 Watt	23%	of Tungsten installations.
250 Watt	2%	of Tungsten installations.

FROM CLARE N. STANNARD, SECRETARY, THE DENVER GAS AND ELECTRIC CO.

The Denver outlook is an exceedingly bright and promising one. We are experiencing a revival of trade along all lines. This is particularly true in our electric sign business. We recently experienced an increase of 286 per cent. over the same month of a year ago.

The tungsten lamp is proving at this time most interesting; our illuminating engineering department and representatives are most satisfactorily handling this situation, pointing out to consumers that by means of this lamp they can secure three times the former illumination for

the same money. We are thus very rapidly increasing Denver's standard of illumination, and through this policy we do not think the lamp will interfere with our revenue.

As to our experience with the inverted gas burning units, would say that Denver is primarily an electric city, and therefore our experience along this line has not been as broad as the experience of many other companies. However, where we have installed this style of light it has proven quite satisfactory. This is particularly true where we have made an installation displacing gasoline plants.

During the past year this company has installed an illuminating engineering department, Mr. C. F. Oehlmann being in charge. We have found this to be a paying proposition in numberless ways. For instance, our consumers are becoming so educated in the use of light that they are frequently asking for consultations with our illuminating engineer, and many of them have gladly availed themselves of his advice, the result being that we are materially improving the standard of illumination; the consumers are better satisfied than ever before, all resulting in a most happy condition.

Denver is, as you know, quite rightfully termed "The City of Lights." The city council recently passed the mayor's annual budget, which makes a liberal provision for increased street lighting. A number of our principal thoroughfares being at the present time very lavishly illuminated and additional streets will soon be equipped with a liberal system of lighting, which will equal or surpass the streets already illuminated. Thus the outlook for increased lighting, both commercial and municipal, is most encouraging.

From H. M. Hirschberg, President, the Excello Arc Lamp Company, New York.

We take pleasure in stating that the progress of the flaming arc business in the past year, so far as our experience goes, has been far greater than our anticipations. The outlook for the coming year is even brighter than the last. Our business last month was 50 per cent. greater than a year ago and 125 per cent. greater than 1907.

The field of usefulness for the flaming arc is continually growing, and while at first we only looked for the installation of flaming arcs for advertising purposes, they have of late been adopted very largely in industrial plants of all descriptions.

We are now working hard in the endeavor to create interest for street lighting propositions, and the prospect for this year is that a large number of cities and towns will adopt them for this purpose.

From J. D. Shattuck, General Manager, Suburban Gas Company, Chester, Pa.

I have not much to say at this time, except that I expect to see the new inverted burner units pushed more extensively this year than ever, and that the competition between this system of lighting and electric tungsten will be very spirited. The gas in this case seems to have the advantage as to quantity of light and economy in cost.

For concealed lighting and some window display the tungsten will probably have the advantage. I believe the gas man and fixture manufacturer will move ahead in the illuminating field this year and out-distance the progress of the last few years. Gas lighting, with inverted burners, is certainly on a new plane compared with the upright burners.

From J. W. Perry, H. W. Johns-Manville Company.

Linolite, as first introduced, consisted of tube filament lamps, approximately 11 in. long, placed end to end in a trough-shaped reflector, with a bead on both edges to house the conductors, and so constructed that the lamps were exactly 12 in. between centers; hence 12 ft. of Linolite is composed of 12 lamps.

During the past year we have brought out, besides this standard form adapted to show case, show window and bulletin board illumination, an attractive and complete line of desk and table lamps, which not only serve to give an evenly diffused illumination, but also eliminate shadows to a marked extent. Picture and bookcase reflectors have likewise been designed, which, through the ease of perfect light control, render a uniform illumination from top to bottom of picture or case, and

confine all the light within the desired space.

Numerous new features are now being developed and will soon be placed at the disposal of the public. Among them may be mentioned the same fittings with high efficiency lamps, varying in intensity from six to forty candle-power. With this flexibility in the light source, few forms of general illumination are beyond the scope of Linolite.

In the near future we expect to introduce tungsten filament Linolite lamps.

From C. W. Hare, Manager New Business Dep't., The United Gas Improvement Company, Philadelphia.

In my opinion there has been great advancement during the past year in this section of the country in the type and quality of the appliances to be used for gas lighting, and while there is still a very large field which has not been covered in this connection I feel that we are to be congratulated on the very substantial progress made.

With the inverted type of gas burners, equipped with ventilated glassware, the objectionable heat and discoloration of ceilings have been reduced to a minimum. This factor, together with the marked improvement in appearance of gas lights, and the improved methods of lighting, has made it possible for us to enter fields which have heretofore been confined almost entirely to electric lights. The satisfaction which these installations are giving, without question will result in still further improvements being made, and the impetus given to the business during the coming year will be far greater than can be realized at this time.

There must be borne in mind, however, that little, if any, advance has been made in the style of gas fixtures, and in my opinion this is a question which requires the immediate consideration and co-operation of every fixture manufacturer in the country. It is only necessary to visit any of the fixture manufacturers' warerooms, in order to see to what extent the development of the electric fixture has been carried at the expense of the gas fixture. Room after room is given over to the careful display of electric fixtures, and in most instances the few gas fixtures, which are shown in a rear room, are generally of the cheapest and most ordinary type.

There is not the slightest reason, in my opinion, why we should not at once begin to develop gas fixtures of artistic design and of very much higher quality than has been the custom in the past, and this is one of the means which must be adopted during the coming year, if we intend to hold the large advantage which has been gained during the past year, by the successful launching of the inverted type of gas burner.

From J. J. Batterman, General Sales Manager, Stave Electrical Co., New York.

There was a time, beginning about three years ago, when the flaming arc lamps were first introduced in this country, that certain sales offered the least resistance, chiefly among which were theatres and moving picture shows. This was entirely owing to the great light power of the flaming arcs, and their overshadowing at approximately a six to one ratio the light of an ordinary arc. This fact gave flaming arcs a distinct advertising value by reason of the conspicuousness of the light, and, therefore, considered more or less spectacular. This was the cause of some of the large mercantile and other high grade business establishments being slow to take up the flaming arc lamps, as they complained of the lamp being identified with a lot of cheap class places.

Time has elapsed and we now find ourselves confronted with the real deserving field for the flaming arc lamps, which is evinced by the activity of all the big railroads and industrial plants, steamship companies, and some of the best mercantile establishments and hotels in the country, adopting flaming arc lamps with a remarkable rapidity. The big industrial plants and railroads are out with specifications calling for installations that number in some instances over a thousand lamps to a single installation. There still remains a field greater than any mentioned which has become actually developed, namely, the street lighting on regulation arc poles in the principal business blocks in towns of all sizes throughout the United States.

PROCEEDINGS

Proceedings of Technical Societies

DISCUSSION

The Formation of The Illuminating Engineering Society in London

REPORTED BY J. S. DOW.

An informal dinner was held at the Criterion Restaurant, Piccadilly, London, W., on February 9th, at which the formation of an Illuminating Engineering Society in this country was the subject of discussion, Mr. Leon Gaster presiding.

At this gathering representatives of the engineering, architectural, medical, and other interested professions, were present.

At the conclusion of the dinner, Mr. Gaster extended a hearty welcome to those present on this occasion as supporters of the movement which they all had so much at heart.

He then referred briefly to those who had expressed their sympathy with the movement, but for one reason or another were unable to be present, including among others: Sir Edward Brabrook, Mr. W. J. A. Butterfield, Mr. C. Carpenter, Dr. C. V. Drysdale, Prof. J. Fleming, Mr. F. W. Goodenough, Mr. A. Kitson, Prof. V. Lewes, C. le Maistre, Sir Joseph Swan, Mr A. P. Trotter, Mr. A. A. Voysey, Mr. P. J. Waldram, Mr. W. H. Y. Webber, and many others.

Mr. Gaster then remarked that they all already had an opportunity of learing the aims and objects of the illuminating engineering movement, and it would only require a few words from him to explain the basis of the suggestion that we should form an Illuminating Engineering Society in this country.

He felt sure that he would have their sympathy in this matter, and desired first of all to give a short summary of the efforts that he had made with this intention and their results.

Mr. Gaster then proceeded to outline the purposes of such a society, and discussed briefly the obstacles he had already encountered since first bringing the matter to public attention, some three years ago, and answered the most important objections which had been raised to its formation. He particularly referred to the success of the American Illuminating Engineering Society, and to the general interest which was being shown in both America and Europe in subjects pertaining to illuminating engineering.

Mr. Defries expressed his appreciation of the high ideals which Mr. Gaster was endeavoring to materialize, and his sense of the value of co-operation between those representing different professions. He had been often struck by the difficulty in securing really reliable data on points connected with illumination, and felt that co-operation between different professions in order to supply these missing links was needful.

Dr. H. Parsons, in reply, fully agreed that the study of the physological effect of illumination, as apart from its actual luminous efficiency, did not receive enough attention. He himself had become interested in the subject through the effect of ultraviolet light on the eye, and the possibility of cataract, which occurred among those working in glass furnaces, being attributable to this cause. This was a typically difficult question on which the co-operation of physicists, chemists, and physiologists was needed. On such a subject very few reliable data were as yet available.

He quite agreed with Mr. Defries that the subject of the physiological effect of light ought to have been taken up long ago. Some attention had been paid to the subject by the medical profession, but their views were not sufficiently impressed upon engineers. He, therefore, felt that a society on the lines proposed by Mr. Gaster might do very valuable work in spreading such knowledge.

Mr. S. D. Chalmers said that he felt there was very much more to be learned about the physics of light production, and the manufacture and use of light in such a way as to be most useful for general illumination. He thought that great benefit would result from the formation of such a society, and wished it every success.

Mr. J. Darch, F. S. I., said that in his experience the study of illumination and the choice of illuminants was of very great importance. He had tried time after time to impress this view on those with whom he came in contact, but had found a great deal of prejudice to contend against.

He felt that the sympathetic co-operation of those joining the society proposed by Mr. Gaster would be a great force in this direction, and he, for his part, would be very willing to do what he could to help the movement forward. He hoped that the medical profession would be well represented because their interest in this matter was very vital, and their influence among a certain section of the public would be exceedingly great.

Mr. A. E. Penn was very glad that Mr. Gaster had afforded him an opportunity of expressing his appreciation of the proposed society. The society of the Engineers in Charge, with which he was connected, was continually aiming at fraternization, and the engineer in charge himself, was always anxious to learn what a specialist in any department had to tell him.

Mr. H. T. Harrison rose to propose the toast of the illuminating engineering profession, coupled with the name of Mr. J. S. Dow.

He himself had been brought up as an electrical engineer, and had taken up the question of street lighting. He had continually been impressed with the need of some impartial authority to weigh the claims of those connected with different systems of lighting, who were, not unnaturally prejudiced in favor of their own illuminants.

Mr. Kenelm Edgcumbe said that his own experience had been chiefly in connection with measuring instruments and photometry. He himself was able to look at the question from an impartial standpoint, and he felt that it would be a great thing both for the industry and the general public if we could meet together and discuss these questions.

Mr. J. S. Dow said that in attempting the study of photometry and kindred questions, he had been very much struck with the exceedingly scattered nature of the data available. One had to toil through the proceedings of very many different British and foreign societies, and at the end of it usually found that the data were expressed from some narrow point of view, which prevented them being properly comparable among themselves.

As an illustration of the fact that the very term "illumination," in the sense in which we use it, was almost unknown until recently, he might mention that when he looked up its use in a well-known encyclopædia, he was rewarded by the cryptic reference "Illumination. *See* Fireworks." He thought, however, that the great aim of the society would be, as Mr. Defries had stated, to promote co-operation. The time had come when no really important general investigation could be carried to a successful conclusion, except by the concerted efforts of workers in the different fields interested.

There had been some complaints that illuminating engineering was over-specialization. Yet it might more fitly be said that "illuminating engineering was amalgamation," for it brought into contact very many people who worked in their own narrow circle and developed ideas without considering how they affected those interested in other aspects.

Mr. Charles W. Hastings said that he had always believed in the necessity for the study of illumination, though he had been less convinced of the necessity for the illuminating engineer. After hearing what had been said on the subject this evening, however, he must now confess that he was convinced, and was particularly struck with the need for somebody to bring out the study of the *use* of illumination as apart from its production—in other words, the need of the illuminating engineer.

Mr. A. Denman Jones felt that there was no need to add anything to what had been said with regard to the formation of the society, but was surprised to find how much he had in common with others in desiring the welfare of this movement.

This proposal was coupled with the name of Col. Leese as the Chairman of the Illuminating Engineering Publishing Company, Ltd., who was unfortunately absent, owing to indisposition. In his absence Mr. Gaster, as co-director, thanked Mr. Hastings and Mr. A. Denman Jones for their kind remarks in connection with the magazine.

It having been proposed by Mr. Charles W. Hastings and seconded by Mr. A. Denman Jones that "the *Illuminating Engineer* (London) be appointed the official organ of the Illuminating Engineering Society in this country," this proposal was put to the vote, and carried unanimously.

Mr. Gaster, in expressing his satisfaction at the sympathetic remarks of those who had spoken regarding the proposed society, said that it had made this one of the happiest days of his life to see this Illuminating Engineering Society coming into existence.

Mr. Justus Eck then proposed that a provisional executive committee be appointed to prepare the statutes of the society and to do

any special work in facilitating the inaugural meeting. He proposed further that the gentlemen present to-night, together with those who had accepted but were unable to be present, should serve as an informal committee of this kind.

Mr. J. W. Ife seconded the proposal.

Mr. Gaster then remarked that the present company was thoroughly representative, and so fulfilled the necessary qualification for an informal committee; officers, etc., could be appointed afterward. The proposal was carried unanimously.

Mr. H. T. Harrison proposed that a small sub-committee be appointed to assist in drawing up rules. Subsequently the following gentlemen agreed to act on this committee:

Dr. H. Parsons, Mr. J. Eck, Mr. H. T. Harrison, Mr. C. W. Hastings, Mr. J. Darch, Mr. J. W. Ife, with Mr. Leon Gaster as honorary secretary, it being understood that others might be co-opted as the committee might think fit.

The dinner terminated about 10.45, but many of those present remained discussing the subjects brought up in the course of the evening until past 11, when the party broke up with mutual expressions of appreciation, and with hopes of meeting again in many pleasant discussions in the future.

Selective Emission of Incandescent Lamps as Determined by New Photometric Methods

By E. P. Hyde, F. E. Cady, and G. W. Middlekauf

A paper presented at the February meeting of the New York section of the Illuminating Engineering Society.

The paper gives the results of recent researches carried out by means that have hitherto been unused. The question as to the cause of the higher efficiency of the new incandescent lamps is not only interesting, but important. In a talk before the society a year ago, Prof. Lummer stated positively that so far as had been thus far determined, the higher efficiency of the new electric lamps was due entirely to the fact that the lamps were run at higher temperatures. The authors of this paper, however, arrived at a quite different conclusion—namely, that one-third of the increase in efficiency is due to selective emission. They used two different methods which gave substantially concordant results. The methods are thus described:

The coefficient of change in candle-power corresponding to 1 per cent. change in watts has frequently been determined for filaments of different materials; but a comparison of the resultant coefficients when the two filaments have the same distribution of energy in the visible spectrum, and the deduction from the results as to the selectivity indicated by a comparison of the coefficients under this condition have never previously been made. This, then, constitutes a second qualitative method of determining positively whether or not one filament radiates selectively as compared with the radiation from a second filament.

In both methods the starting point has consisted in bringing the two filaments to the same distribution of energy in the visible spectrum by means of spectro-photometric measurements. The same result can be accomplished, however, in a very much simpler manner. The eye is very sensitive to slight differences in tint. If, therefore, a lamp at a definite voltage be placed on one side of a Lummer-Brodhun photometer screen and the voltage of a second lamp placed on the other side of the screen be varied, one can determine with considerable accuracy when the second lamp has the same distribution of energy in the visible spectrum as the first lamp by varying the voltage until the two sides of the photometer screen appear to have the same tint.

It is quite a simple matter, therefore, to compare the relative selectivity of two lamp filaments by either of the two methods given above. Thus, subjecting one filament to some definite voltage, the voltage of the other filament at which its light has a color match with the light from the first filament is determined. Then according to the first method the total luminous flux and the watts supplied to each lamp are measured and the lumens per watt are calculated. If the two values are the same, the lamps are relatively not selective. If the two values are different one lamp is selective with respect to the other. By taking as a standard lamp a carbon-filament which approximates a black body and is not selective to any extent, one can determine whether the radiation from another filament is, or is not, selective.

One can see from the results that if the assumption [contained in the previous paragraph] is true, an osmium lamp at the same true temperature as that at which an anchored oval treated carbon filament operates when consuming about 3.1 watts per mean horizontal candle—color match with standard carbon lamp at about 115 or 120 volts—would show an efficiency higher than that of the carbon lamp by more than 35 per cent. or 40 per cent.

American Items

Brightening the Bank, by Earl E. Whiteborn; *Selling Electricity,* February.

Sets forth the advantages of the electric sign for banking institutions, and illustrates such use in several cities in different parts of the country.

The Bearing of Modern Illumination Upon Physiological Optics, by Sydney W. Ashe; *Electrical World,* February 25.

The article is a report on the results of experiments being carried on at Columbia University by the writer in collaboration with Mr. Rice, under the co-operation of the departments of Physiology and Physics. A large number of measurements have been made upon the variation of visual accuity for lights of different intensities and of different intrinsic brightness. Other phases of the investigation have been to determine the effect upon visual acuity of foreign lights placed in field of vision—the effect of size and shape of different letters upon one's ability to read, and the effects of accommodation and fatigue. Particular attention has been given to the development of new apparatus for making accurate measurements, the standardization of instruments, and the elimination, so far as possible, of physical and physiological errors. The subject is treated in a strictly scientific manner, and illustrated with several diagrams, and is a valuable contribution regarding the particular problems investigated.

New Street Lighting System in Aurora, Ill., by C. J. McCarty; *Electrical World,* February 25.

A detailed description of the new, artistic lighting system recently installed in that city, which consists of 173 ornamental cast iron posts, those at the corners of the street intersections carrying five lamps, and those between, four. The arms of the posts curve downward, each supporting a 100-watt tungsten lamp in a 10-in. opalescent globe. At the center of the post in an upright position is a 60-watt lamp in a 12-in. globe. The work was installed at a cost of $2.16 per front foot of street, or at the rate of $103 per post, which includes the cost of transformers, and of labor and material outside of extra power sources, equipment and the like.

The Mean Spherical Candle-Power of the Standard Candle. Answered by the Bureau of Information of the American Gas Institute. *Progressive Age,* March 1.

According to measurements made by Professor Ayrton, and reported in the London *Journal of Gas Lighting,* February 6, 1894, a value of .88 is arrived at. Mr. C. O. Bond, however, by using the graphic method with Professor Ayrton's figures, arrives at a value of 1.01. The fact that the mean spherical is slightly higher than the horizontal is ascribed to a slight reflecting power of a tallow cup of the candle, and is shown in the distribution curve, which runs outside the candle power intensity through nearly the whole of the upper-hemisphere.

The Problem of Efficiency in Illumination, by Arthur J. Sweet; *Electric Journal,* March.

Probably the clearest and most succinct exposition of this subject that has ever been presented in a single article. It is

impossible to abstract without mutilating the writer's logical development, but the following quotations will show the clearness and sound scientific knowledge which characterize the article:

In most fields in which the engineering sciences are applied the question of efficiency is one which must receive the serious consideration of both the designing engineer and the man who pays the bills. In few of the applied sciences, however, is efficiency of such supreme importance as in illumination.

There are possibly two questions which may be raised by those who hesitate to accept the statement that the problem of illumination is essentially a problem of efficiency. One party may say, "We agree that the issue is one of satisfactory illumination at low cost. But is efficiency of operation the all-important factor of the cost? Is not the useful life of the illuminating apparatus of equal or greater importance?" The question here raised can easily be settled beyond dispute and once for all. Within the range of cost at which electrical energy is commonly available to the user of light—8 to 15 cents per kw-hr.—the renewal cost is almost negligible as compared to the cost of power. If a less efficient lamp had been taken as an example, the life of the lamp would have appeared as a still less important factor.

In the case of gas in open burners, and spirit or oil illuminants, the life of the illuminating apparatus is a very trivial factor in the total cost of operation. In the case of the gas mantle, the Nernst lamp, the mercury vapor lamp, or any of the various forms of arc lamps which are in commercial use, the renewal cost bears to the power consumption cost a relation similar to that which has already been found true for the incandescent lamp in that the useful life of the apparatus is of minor importance, as compared with efficiency.

Others may assert that the artistic quality is frequently of more importance than efficiency. If artistic merit and efficiency were antagonistic or even independent principles, these critics would be right; but in illumination, as in many another applied science, art and efficiency go hand in hand. Not all so-called artistic installations are efficient; but the truly efficient installation is almost invariably artistic. For example: a false sense of the artistic decrees that incandescent lamps should not be suspended vertically from the chandelier, but at an angle to the vertical. The same artistic sense has surrounded lamps with a reflecting glass shade. With such an installation, the light is thrown directly in the face of any one facing the chandelier. The result is not merely unpleasant, but inartistic in the highest degree. Had the problem of efficiency first been studied, it would have been found that the most efficient position, the vertical, is also the most artistic in the illumination results obtained.

The general laws upon which efficiency of illumination depend are the fundamental laws of the science of illuminating engineering. Our natural and only logical procedure, therefore, is to analyze the various factors which determine efficiency of illumination and to recognize and classify the laws according to which these factors act. At the outset, it is necessary to have a clear conception of what is meant by efficiency in illuminating engineering. In the older engineering sciences, efficiency is the useful energy out-put divided by the energy in-put, expressed as a percentage; and in most engineering work the end sought is the transformation of one purely physical form of energy—mechanical, electrical, chemical—into another purely physical form. In illumination, however, the end sought is a physiological process, sight. The difficulty of measuring efficiency of illumination at once becomes apparent. Watts and horse-power can be reduced to a common unit, but what common unit can be found between watts and the sensation called clear vision? Does clear vision under different illumination conditions represent always the same amount of energy expended in the physiological process. Can, indeed, any satisfactory unit of "clearness of vision" be found, whether energy unit or otherwise? The illuminating engineer has as yet no *unit* of efficiency. None the less, the term efficiency can be used and the distinctions of higher and lower efficiency can be drawn. In illumination there is, for any given installation, a fairly definite condition known as "good illumination." For any given plane of reference, or for any combination of such planes, the relation of efficiencies of two different schemes of illumination will be the inverse relation of the energy in-put required to produce "good illumination" in each case.

"Good illumination" is indeed a rough and inexact measure for a science seeking to be exact. However ill we like it, we will be the better engineers for clearly recognizing that it is at present the only measure we have of useful, energy out-put, of the energy which is active in stimulating the optic nerve and producing visual perception.

When the term "efficiency of illumination" is considered closely, it is seen that in this term is included the combined effect of three different kinds of efficiencies. First, there is the efficiency of visual perception, this being the efficiency with which the eye receives light energy and transforms it into visual perception. Second, there is the efficiency of light distribution, by which is meant the relation between total light energy generated and light energy useful in producing desired conditions for visual perception. Third, there is the efficiency of the light source, by which is meant the efficiency with which chemical or electrical energy is transformed into light energy. None of these factors is trivial, each is of importance in determining the resultant efficiency of illumination. It has been the error of the past to lay all the emphasis on the efficiency of the light source.

To obtain efficient illumination we must have efficiency of visual perception, of light distribution, of light source—all three. What, then, are the conditions upon which each of these three kinds of efficiencies depends?

Efficiency of visual perception depends upon three conditions. These are (a) the intrinsic brilliancy of the light source and of the surrounding light-reflecting objects; (b) the color of the light, and (c) the intensity and steadiness of the light. Each of these conditions will be briefly considered in turn.

Intrinsic Brilliancy of Light Source—The eye adjusts itself to various degrees of light intensity by the automatic expansion or contraction of the pupil or opening in the iris diaphram through which light is admitted to the eye. Now the light which is active in causing a greater or less contraction of the pupil is not merely the light which comes from the centre of the field of vision, but the light which comes from the entire field of vision. The light which is active in causing visual perception, however, comes under normal conditions entirely from the central portion of the field of vision. The same amount of light, therefore, falling upon and reflected from the given visualized object may produce very different degrees of illumination due to changes in the size of the pupil, such changes resulting from differences in the intrinsic brilliancy of the outlying portions of the field of vision.

Color of Light Used—With the same light intensity as measured in foot-candles, lights of different color give appreciably different illumination values. Where objects of a great variety of color are to be viewed, the best light has the quality of summer daylight, i. e., light containing all wave lengths, but having a slight preponderance of the green rays.

Foreign Items

COMPILED BY J. S. DOW

ILLUMINATION AND PHOTOMETRY

One of the most interesting items of news during the past month is the decision arrived at an informal dinner held at the Criterion Restaurant, Piccadilly, W. on February 9, to form an Illuminating Engineering Society in this country. The dinner was attended by a gathering representative of all the chief trades and profession interested. It was also decided that the *Illuminating Engineer*, published in London, should be the official organ of the society, and a provisional committee was appointed in order to discuss the formation of statutes, &c., previous to an inaugural meeting to be held shortly.

The *Gas World*, commenting on this matter (February 20), has no doubt that representatives of the gas industry will be welcomed, but raises the old doubt whether those connected with the interests of gas, electricity, &c., can be brought together in peace.

ILLUMINATION, ITS DISTRIBUTION AND MEASUREMENT (Continued), by A. P. Trotter (*Illuminating Engineer*, London, February).

The present installment of this series of articles discusses the Ritchie Wedge and several allied photometers.

THE ART OF SHADING, by J. F. S. I. Darch (*Illuminating Engineer*, London, February).

An illustrated article discussing the

placing and shading of sources so as not to offend the eyes.

THE HISTORICAL DEVELOPMENT OF STREET LIGHTING IN LONDON DURING THE SEVENTEENTH AND EIGHTEENTH CENTURY (*Illuminating Engineer*, London, February).

An article describing the old statutes, &c., in London regulating the lighting of the streets. Some illustrations are given of the lawless and unsafe state of the streets at the times mentioned, when illumination had not yet become a public concern. Any lighting that was carried out was regarded as the duty of individual householders who had to hang suitable oil lanterns outside their doors.

SOME PRACTICAL POINTS IN THE DESIGN OF FIXTURES (*Illuminating Engineer*, London, February).

Discusses the support of glass shades, &c., condemning the method of relying on the rings attached to the lamp holder for this purpose. Globes ought to be provided with separate support apart from the electrical and current carrying apparatus. It ought also to be possible to get the fingers inside a shade with comfort in order to unscrew the rings, or, better still, each shade should be provided with a carrier, allowing it to be completely removed in order to allow free access to the holder.

ILLUMINATING ENGINEERING (Editorial), *Elec. Engineer*, February 19).

HISTOIRE DE L'ECLAIRAGE DES VILLES (*Revue des Eclairages*, February 15).

ELECTRIC LIGHTING.

DIE STEUER AUF BELEUCHTUNGSMITTEL FUR ELEKTRICITAT UND GAZ (*E. T. Z.*, January 28, Dettmar).

DER ENTWURF DES ELEKTRICITATSSTEUERGESETZES IN TECHNISCHER BELEUCHTUNG (*Elek. Anz.*, January 21).

DIE BESSTEUERUNG DES BELEUCHTUNGSMITTEL (*Z. f. B.*, February 10).

Articles complaining of the suggested tax on gas and electricity in Germany; it is now urged by electrical engineers that besides being impracticable as a source of revenue, the tax is not even, and that the electrical industry would be called upon to pay three-quarters of the total tax and the gas industry only one-quarter.

MODERN METHODS OF ILLUMINATION. (I) ELECTRIC LIGHTING, by Leon Gaster, editor of the *Illuminating Engineer*.

This was the first of four Cantor lectures on illumination to be delivered before the Royal Society of Arts. The lecture covered the general ground of the subject, and was illustrated by a very representative collection of the latest types of glow lamps, arc lamps and mercury lamps. These included the Jandus inclosed regenerative flame arc lamp, the new Excello lamp provided with means of keeping the globe free from the deposit due to fumes and equipped with the prismatic inner globe added in order to improve the natural curve of light distribution from the point of view of street lighting, and the Crompton-Blondel lamp.

In commencing the lecture special reference was made to the importance of considering the eye as a factor in designing modern methods of illumination; this lecture will be published in abstract in the London *Illuminating Engineer* and in full in the *Journal* of the Royal Society of Arts.

SPECIFICATIONS DES LAMPES ELECTRIQUES (Communication to the Congress held at Marseilles last year, F. La Porte).

A general review of the existing specifications for the sale of electrical lamps in different countries.

METALLIC FILAMENT LAMPS, by W. H. F. Murdoch (*Elec. Rev.*, January 28).

An article dealing with the effect of voltage fluctuations on the performances of metallic filament lamps; the author discusses several theories to account for the behavior of tantalum filaments on alternating current circuits and refers to the "overshooting effect" in tungsten lamps.

ELEKTRISCHE BELEUCHTUNG VON PERSONENWAGEN, by E. Dick, (*E. T. Z.*, January 21).

Gives some details of the principles un-

derlying the application of electric lighting to railway carriages.

METALLIC FILAMENT LAMPS, by W. A. Barnes (*G. W.*, January 30).

METALLISCHE LEUCHTFADEN IN DER FABRIKATION UND IN DER PRAXIS, by B. Duschnitz (*J. f. G. abstr.*, February 13).

DIAGRAM - WATTMETER (*Glühlampenprüfer*), (*Elek. Anz.*, January 28).

A STUDY OF THE ECONOMICAL POSSIBILITIES OF LIGHTING BY CARBON FILAMENT LAMPS (*Illuminating Engineer*, London, February).

GAS, OIL, AND ACETYLENE LIGHTING.

EDITORIALS.

FLAME ARCS VS. HIGH PRESSURE GAS LIGHTING (*J. G. L.*).

HYGIENIC ADVANTAGES OF GAS OVER ELECTRICITY (*J. G. L.*, February 9).

RECENT ADVANCES IN STREET LIGHTING IN BERLIN, by Prof. H. Drehschmidt (*J. G. L.*, January 26, February 2 from the *J. f. G.*).

An abstract of the article on this subject recently appearing in the *Journal fur Gasbeleuchtung;* commented upon previously.

GAS LIGHTING IN THE UNITED STATES (*J. G. L.*, January 26).

This article is largely devoted to a discussion of the attitude of the *Illuminating Engineer* in the United States toward the gas industry, and it is concluded that this journal is doing a very fair share of the work of stimulating the progress of gas lighting.

MODERN METHODS OF ILLUMINATION. (II) GAS LIGHTING, by L. Gaster. (Lecture delivered before the Royal Society of Arts, February 22).

The speaker traced the development of gas lighting from the time of the flat flame burner up to the high pressure systems and inverted mantles of the present day. A number of examples of different high pressure and self-intensifying lamps were exhibited, including the new Keith and Blackman lamps now installed in Fleet street, running on about 50 in. of water and credited with 60 to 70 candles per cubic foot of gas. These lamps were fitted with the new electric ignition system exhibited for the first time in public. Other self-contained pressure raising lamps were the Lucas thermopile, in which a thermopile supplies current to a small electric motor at the base of the lamp which creates the desired draught, and the Chipperfield lamp in which the same end is reached by the use of a small hot air engine. Examples of the newest forms of inverted mantles and of various systems of pneumatic and other systems were also shown. In conclusion, the lecturer discussed the possibility of testing gas on a calorific basis and dwelt upon the attitude of modern gas companies to the consumer.

UBER MODERNE PRESSBELEUCHTUNG by LEBEIS (*J. f. G.*, February 6).

Discusses the subject of high pressure gas lighting in a general manner, and gives some details of the Colonie lamp.

PRESSURE AND CLOCKWORK CONTROLLERS, by H. W. Prescott (*G. W.*, February 23).

ELEKTRISCHE GASFERNZUNDER UND IHRE ZULASSUNG BEI ANLAGE VON GASBELEUCHTUNG IN SCHAUFENSTERN, (*J. f. G.*, January 30).

Two articles describing methods of automatic ignition, by pressure, clockwork and electrical methods.

NEUER GLUHKORPER FUR HANGEGASGLUHLICHT, by O. Brandt (*J. f. G.*, February 6).

A SMALL ELECTRIC LIGHTING PLANT IN WAKEFIELD, by H. Townsend (*F. G. L.*, February 23).

THE GAS OF THE FUTURE, by W. H. Y. Webber (*G. W.*, February 13).

THE IMPURITIES IN ACETYLENE, by J. W. Gatehouse (*Acetylene*, February).

THE GRATZIN HIGH PRESSURE INVERTED LAMPS (*J. G. L.*, February 16).

NEUE INVERTBRENNER (*Z. f ½. B ½.*), (*Z. f. B.*, February 10).

Contractions used:
E. T. Z. Elektrotechnische Zeitschrift.
Elek. Anz. Elektrotechnischer Anzeiger.
G. W. Gas World.
J. G. L. Journal of Gaslighting.
J. f. G. Journal für Gasbeleuchtung und Wasserversorgung.
Z. f. B. Zeitschrift für Beleuchtungswesen.

Ornamental
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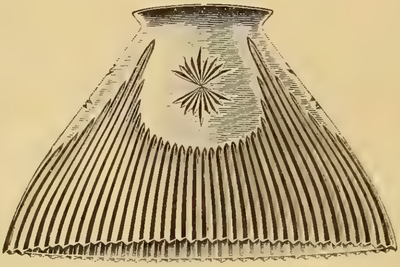
Efficient



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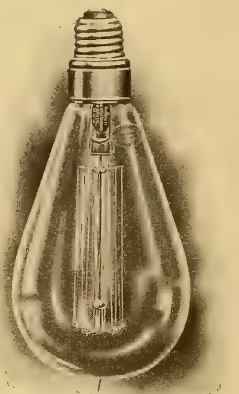

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The Superintendent of Lamps and Lighting of the City of Baltimore, City Hall, desires to purchase incandescent gas and gasoline lamp burners for street lighting purposes—the burners to produce a light equal to between 55 and 60 candle power.

In addition to the above and with a view to the improvement of the present equipment, information is desired concerning the most modern type of incandescent gas and naphtha street lighting fixtures and the terms upon which such fixtures can be obtained by this City.

In order to demonstrate the light-giving power and the artistic appearance of such equipment, tests and street exhibitions may be made, if necessary.

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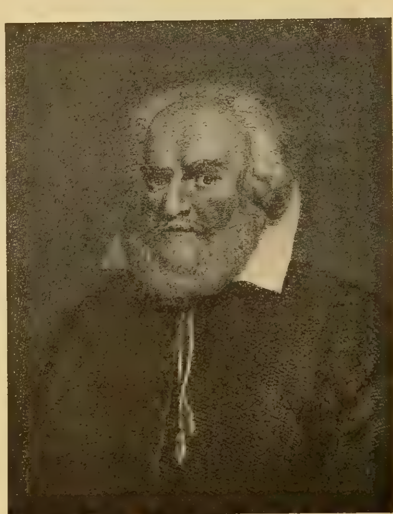
Wisdom of the Drama



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"*Eastward Ho.*" *Act 1. Sc. 1.*

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2. Because no medium existed for directly enlisting the patronage of those active and infuential in the work of designing, installing and renovating lighting systems, or for educating and impressing upon the consumer the vital importance of illuminating engineering.

Now it is different: A manufacturer can come into due prominence and secure for his products the recognition which they deserve through the advertising pages of THE ILLUMINATING ENGINEER in a far shorter time and at vastly less expense than was possible previous to its creation.

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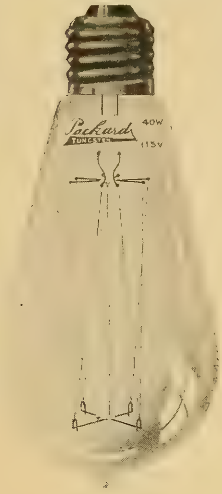

25 Watt Tungsten
40 Watt Tungsten

40 Watt Tungsten
Regular Edison Base

Packard Lamps

Packard Lamps

60 Watt Tungsten

100 Watt Tungsten

Packard Lamps

1¼ Watts
Per Candle

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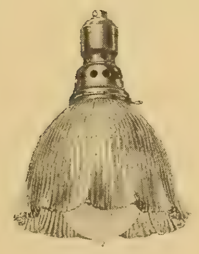
Extensive



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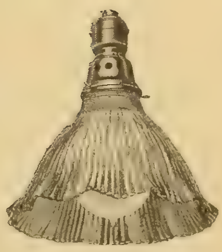

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Vol. IV APRIL, 1909 No. 2

THE LONGER DAY

"The night cometh when no man can work."

Who would not retard the flight of time if he could? Who has not found the day all too short for the manifold duties and pleasures which are planned for its twenty-four hours? There is always so much to be done, and so much that has to be left undone.

The length of the day is measured by what we accomplish: to lengthen the day is to lengthen life.

As the day has been lengthened in effect by the telegraph and the telephone, the steam railway and the trolley car, and the thousand time-saving devices, so also has it been lengthened in fact by the use of modern light-sources. This beneficent contribution of science should be made to contribute equally to our use and our comfort. Let us light up our city streets so that they become a thing of beauty and a joy forever, and then use them for pleasure and profit to the uttermost.

It is a manifest absurdity to lavish light upon a street at night, and then bar the doors of the various establishments which constitute the street and so convert it into a mere uninhabited roadway.

With modern methods of illumination there is not a single line of merchandise which may not be as carefully inspected and as intelligently bought and sold at night as in the sun-lit portion of the day.

Why should we take time from that portion of the day when we have regular and unremitting work or duties to perform, in order to carry out the occasional pleasures and duties for which the evening offers so much more freedom? Why should we be obliged to spend the crowded hours of daylight for shopping any more than for the theatre or opera?

Let us have the stores open evenings, so that what is now generally considered a necessary evil may become a source of recreation and enjoyment. The brilliantly illuminated street and the closed store is an anomaly for which no sufficient reason can be adduced.

Let us make every legitimate use of the lengthened day which modern illumination has given us, and so in very truth lengthen our lives by the same measure.

Let there be *more* light!

E. L. Elliott.

FIG. 1.—ORIGINAL BRONZE GAS STANDARD, U. S. CAPITOL GROUNDS. FIG. 2.—BRONZE GAS STANDARD, EQUIPPED WITH WROUGHT IRON EXTENSION FOR ARC LIGHTING. FIG. 3.—BRONZE POST AND STAIR RAILING. FIG. 4.—BRONZE NEWEL POST.

Lamp Posts in the District of Columbia

By Walter C. Allen.

Closely allied to successful street lighting is the character and design of the standards used to support the lighting fixtures. Little attention has been paid in the past to the appearance of the ordinary lamp post in use in most American cities, but in recent years, however, an awakening has taken place, and efforts are being made in many municipalities to erect artistic posts, at least where extensive improvements are made in the illumination of particular streets. The weeding out of old, unsightly posts must necessarily progress slowly, for no large city is prepared to spend hundreds of thousands of dollars at one time for such a purpose.

The capital city of the nation in this respect differs in no way from other American municipalities, although around some of the magnificent public buildings are posts of beautiful design and workmanship. The posts on her streets are of plain, simple designs, executed as cheaply as possible in cast iron, and represent the efforts of successive officials to secure something approaching a pleasing type. They present no features worthy of imitation, and are not therefore reproduced in this paper.

The Capitol building reached its present completed stage during the days of gas lighting, and all the beautiful lighting fixtures surrounding it were designed for use with that form of illuminant. In fact, the records show that the building itself was a favorite experimental ground for new gas lighting devices. The introduction of electricity has required a change in the fixtures, both inside and out. In the former case, many of the old gas fixtures have been replaced by beautiful bronze electroliers, but the more massive outside fixtures, forming as they do a part of the architectural treatment of railing and balustrade and pylon have been equipped with new tops adapted to electric arc lighting. While the illumination of the grounds has been improved by the newer form of lighting, the appearance of the posts has suffered in conse-

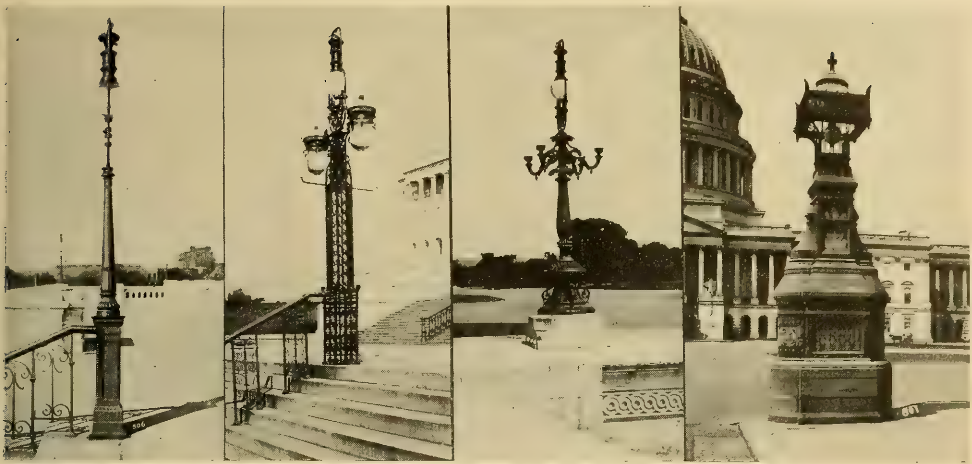


FIG. 5.—BRONZE POST AND RAILING, U. S. CAPITOL GROUNDS. FIG. 6.—WROUGHT IRON POST AND RAILING. FIG. 7.—BRONZE LAMP STANDARD. FIG. 8.—GRANITE AND MARBLE PYLON, WITH ARC LAMP HUNG IN THE ORIGINAL BRONZE GAS LANTERN.

quence. The posts themselves are of all types, from a common cast iron standard (not illustrated here) to elaborate bronze shafts, some of which present ideas well worthy of being followed in designs for use to-day.

The history of the lighting of the Capitol is most interesting reading.

"On April 5, 1840, Architect Mills made a report on the expediency of lighting the public grounds (surrounding the building) with carbureted hydrogen as a substitute for oil. After an elaborate review of the subject, he concluded that it would be safer, more manageable and economical. In 1841 experiments were made with gas lighting apparatus by Robert Grant. Nothing further seems to have been done in this direction until 1847, when a thorough plan of lighting the building and grounds was begun. A mast over 100 ft. high was raised on the dome of the Capitol, on which was placed a lantern 6 ft. in diameter. This was to contain the solar gas light prepared by James Crutchet, giving a light equal to 30,000 candles, and capable, the inventor calculated, of extending its rays as far as Baltimore, thirty-nine miles distant. The interiors of the Senate, House and Rotunda were to be lighted in the same manner."

From this time on appropriations were made for extending gas pipes throughout the building and grounds, for the purchase and erection of gas fixtures and posts and for maintenance of gas lights.

"In 1864 arrangements were made for introducing Garden's magnetic gas lighting apparatus, which was installed in 1865, and March 2, 1867, the rotunda was lighted by

FIG. 9.—BRONZE STANDARD, MAIN STAIRWAY, LIBRARY OF CONGRESS.

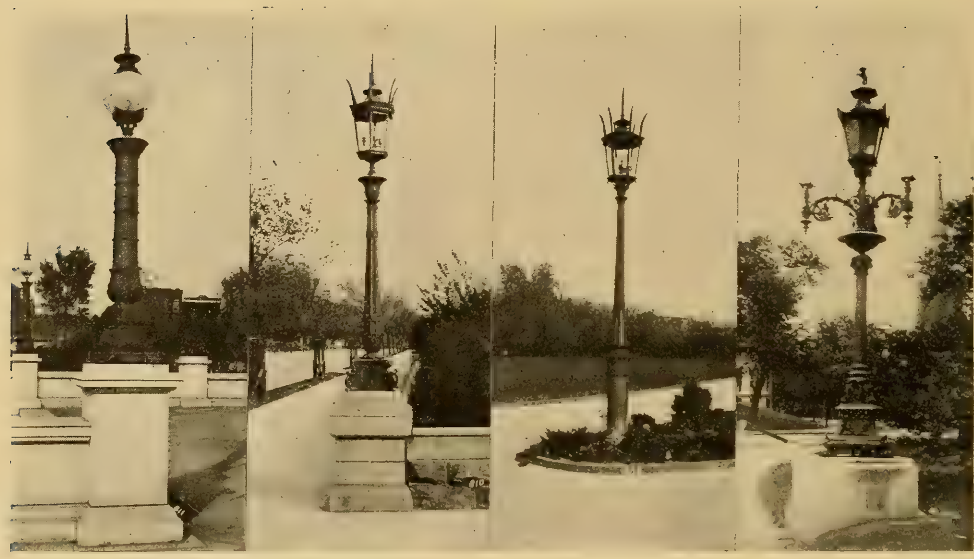


FIG. 10.—BRONZE NEWEL POST, LIBRARY OF CONGRESS. FIG. 11.—BRONZE NEWEL POST, LIBRARY OF CONGRESS. FIG. 12.—BRONZE LAMP POST, ELECTRO BRONZE FINISH, LIBRARY OF CONGRESS. FIG. 13.—BRONZE LAMP POST, THOMAS CIRCLE.

gas ignited by electric current. In the year 1878 a commission was appointed to investigate the question of lighting the building by electricity. In 1880 I. H. Rogers, who had charge of the electric gas lighting in the Capitol, made experiments on the different patented electric lights and reported that he did not consider them steady enough for lighting a legislative hall. The report of 1881 shows the electric lights still unsatisfactory. * * * * In the year 1884 the United States Electric Light Company, at their own cost, were allowed to install arc lamps at the top of the steps of the north, south and west approaches; and the Brush-Swann Company were allowed to place in the dome experimental lamps which they thought would illuminate the grounds and

FIG. 14.—CAST IRON STREET LAMP POST. FIG. 15.—CAST IRON POST AT BRIDGE OVER RAILROAD TRACKS, MARYLAND AVENUE, S. W. FIG. 16.—CAST IRON POST, T STREET BRIDGE. FIG. 17.—CAST IRON POST, K STREET BRIDGE.

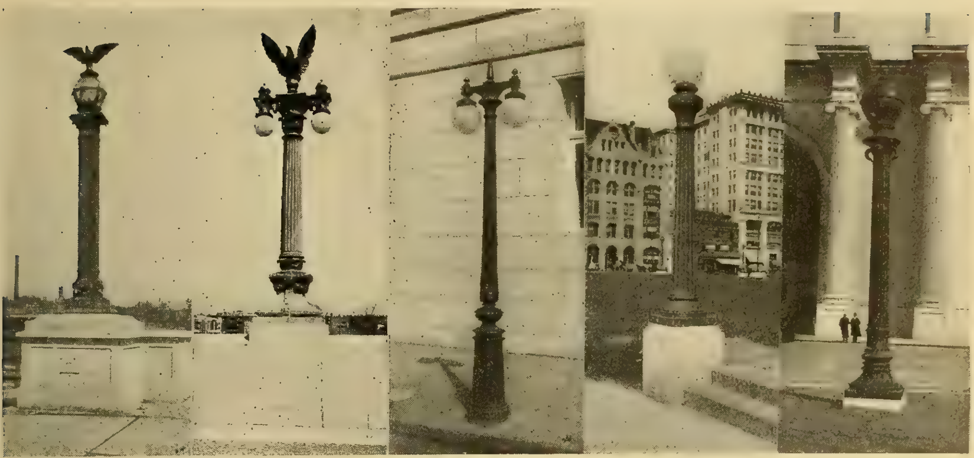


FIG. 18.—CAST IRON POST, POTOMAC PARK. FIG. 19.—CAST IRON LAMP POST, CONNECTICUT AVENUE BRIDGE. FIG. 20.—CAST IRON LAMP POST, SURROUNDING NEW MUNICIPAL BUILDING. FIG. 21.—CAST IRON LAMP STANDARD IN FRONT OF NEW MUNICIPAL BUILDING. FIG. 22.—CAST IRON LAMP POST, NEW UNION STATION, FITTED WITH INVERTED ARC LAMP WITH MAGNETITE DEFLECTOR.

avenues around the Capitol. The Edison Company were allowed, in 1885, to place incandescent lamps in the cloak rooms and lobbies and on the stairways. The arc lamps were found objectionable because they attracted such a large number of insects around the building. * * * * The use of electric lighting proved so satisfactory that arrangements were made in 1895 to purchase the electric plants in the Capitol. * * * * Electric lights replaced gas in the space over the ceilings of the House and the Senate in 1897. * * * * During this year a contract to light the grounds by electricity was carried out. * * * *."

The method of lighting the grounds installed in 1897 is that employed to-day, and the illustrations given here show the old gas posts adapted to the new form of illuminant.

In contrast with the Capitol fixtures are those around the Congressional Library building, where electricity has been used exclusively. Four types are to be seen here, all but one being executed in bronze. The fourth, shown in Fig. 12, is of cast iron, treated with an electro-bronze coating, and now, after twelve years of service, shows excellent wear.

After remaining idle for over twenty years, four beautiful bronze posts (Fig. 13) surrounding the statue of General Thomas, in the circle named after him, have been placed in service. Prismatic glass globes, equipped with tungsten lamps, have replaced the old gas lanterns, and when lighted at night present a very pleasing appearance.

There are a number of public conveniences, such are letter boxes, police boxes, fire alarm boxes, street designations, cable testing stations, etc., each requiring some form of standard, which, with the street lamp posts, form serious obstructions on the crowded downtown thoroughfares. It is not a difficult matter to combine some of these on one post, and as far as the street lamp and the street sign are concerned, New York City has set a good example where arc lamps are used to light the streets. That other combinations are possible can be seen from examples in Washington. The posts here are in three sections—a base, a middle box section, and a shaft—all interchangeable. The base is of ample size inside, and can readily be used as a testing point for such small cables as are employed in municipal fire alarm and police patrol systems, access being had through a locked door. This flexibility of arrangement has been found of great practical value in Washington. Another use which can be made of this plan is the interchangeable post in which incandescent lamps and illuminated signs are combined.

The improvements incident to the re-

FIG. 23.—CAST IRON POST, NAVY YARD BRIDGE. FIG. 24.—CAST IRON LAMP POST, NEW UNION STATION, FITTED WITH INVERTED ARC LAMP WITH MAGNETITE DEFLECTOR. FIG. 25.—CAST IRON STANDARD, AT ENTRANCE NEW MUNICIPAL BUILDING.

moval of all grade crossings over the steam railroad tracks in the District of Columbia and the construction of the new Union Station, begun in 1904 and now practically completed, as well as the numerous other public improvements of the past five years, have stimulated an interest in proper lamp post design. Figs. 15 to 25 show some of these recent designs, which, in every instance, have been executed in cast iron. Only two of the five types of posts around the Union Station have been erected, those in Figs. 22 and 24; others are in course of construction. A very unique and ornamental type of street sign, adjustable to almost any angle, has been designed by one of the prominent architects of Washington for use on old gas posts, and is executed in cast iron. A post designed for use with arc lamps on streets where there are no trees to obstruct the light, or where the posts are to be placed in the center of the roadway, consists of a simple column with a lyre surmounted by a metal canopy.

Lighting a Nation's Highway

By A. Cressy Morrison.

Who, outside of the United States Light-House Board and the river men, knows that the Mississippi River, the Ohio, the Tennessee, the Monongahela, the Great Kanawha, and the Illinois are so lighted from end to end by a series of beacon lights that it is practically impossible, during the entire length of these great arteries of commerce, for the navigator to pass out and beyond the beneficent beams of one beacon without finding himself in touch with another just ahead? He may, therefore, in the darkest nights, thread his way through the tortuous channels from the head of navigation of any of these rivers to the Gulf of Mexico in safety.

The number of beacons which are kept burning every night on the greater part of this great drainage basin of the central United States is somewhat over 2000. The number of light keepers employed is 1500. Three light-house tenders are required for the transportation of supplies, and these tenders are really quite large and imposing steamers.

The Missouri was not mentioned among the rivers, as at present it is practically unlighted from its entrance to the Mississippi to Kansas City, although at one time

its commerce was of great importance.

The nation's great river highway of commerce extends over 4000 miles. Think of the sharp contrasts in temperature and in scene which this vast river system presents.

First, the Monongahela, rising in West Virginia, is lighted due south from Pittsburgh into the mountain fastnesses, the Great Kanawha from the Ohio up and beyond Charleston, then the Tennessee down through old Kentucky across Tennessee, with the last light up the river in Alabama. Think of the great Ohio carrying its burdens of commerce on its mighty breast past Ohio, West Virginia, Kentucky, Indiana and Illinois, then the upper Mississippi, with its branches, into the center of and across Illinois, lighted from the falls of St. Anthony down to Cairo, the beacons sending their encouraging rays from the shores of Minnesota, Illinois and Iowa, and literally "showing Missouri," and the while lighting up Illinois' "darkest Egypt." From Cairo south, the beacons follow the tortuous passages of the lower Mississippi, disclosing the shifting silt bars, marking the treacherous and falling banks, locating a channel which may shift miles in a week and all of these 2000 beacons in the 4000 miles kept continuously trimmed and burning.

The beacons themselves are still old-fashioned kerosene lights set in projecting metal boxes with glass sides, the light being focused by a lens in such a way that much of the illumination is concentrated directly on the lines of vision. These beacons are set upon poles 12 or 15 ft. high, with two boards crossing behind them, and this structure is painted white, so as to act as a guide by day.

On clear nights they can be seen for many miles. They are tended night and morning by light keepers, most of whom are typical darkies of the south, though in the Northern rivers there are many white men employed. Sometimes it is a reliable old colored mammy on whom the Government depends. Perhaps the old and gray-haired Uncle Remus, with crutch and cane, derives his sole income from tending a single light. The Government pays these men from $6 to $12 a month. Strict account is kept of the oil used, and in this way they are sure that the lamp is turned out in the morning and lighted again each night. Rain or shine, mid ice or snow, when floods are high, in spite of caving banks, these faithful servants of the nation must and do keep their beacon lights ever burning.

While kerosene has well served its purpose, it was decided by the Government that owing to the greater brilliancy and wonderful concentration of acetylene in the focus of the lenses that it should be substituted, if possible, for kerosene, especially on the lower Mississippi from Cairo south. It was first proposed that a domestic generator, such as is used with such marvelous success for home illumination, should be set in a little house upon the bank and, as it would not need any attention, week in and week out, and might be arranged to burn for months, this would be an ideal means, and save the heavy expense of beacon light keepers. Then it appeared that steel cylinders might be filled with compressed acetylene and that these might be strapped with metal bands to the post from whence a pipe might be led into the lanterns, and as the cylinders might be made large enough so that the acetylene would burn for months without attention, this would seem to solve the problem.

There was dismay among the beacon light keepers, for they saw their occupation gone. The brilliancy of acetylene, the penetrating quality of the rays, and the great economy seemed to make it imperative that the Government should act. Those who approached the subject believing that acetylene in this case was destined to supersede kerosene, as it is rapidly doing in domestic illumination, had not, however, reckoned with the conditions which were to be met. They did not remember that there is at least one freshet season each year, and that the height of the river is such that the banks are overflowed back to the levees. In some places the river rises upward of 50 ft. When this immense volume of water is thrown from one curve of the river back to the next, it attacks the bank with irresistible force. It literally melts the hardened silt and reduces it to river mud, eating its way into the banks with such rapidity that a

change of a mile may take place in a single day. Forests which have remained undisturbed for a century are seized by the mighty grip of the river, land, forest and all being taken seaward. Lights located where this occurs must be removed quickly or they, too, will go, and many a faithful light keeper in his endeavor to save his light has been drawn into the muddy depths and eternity.

Of the 433 lights between Cairo and New Orleans, not more than 90 are permanently located. Many of these lights are lost each year. Over 300 of them must be changed, and some are changed as many as four times in a single year. Without the light-house tender and its men, the heavy acetylene cylinders or the generator housings would have to go, and, therefore, acetylene at present seems impossible. Nevertheless, the lights now are very efficient, and when it is considered that the mighty commerce of all these rivers is conducted with comparative safety because of the pathway of light so faithfully maintained by the simple minded but always faithful light keepers, who regard their light so highly that they will defend it with their lives, the lighting of the Nation's Highway is a wonderful thing. This is little known, but great work is quietly being done by our good old friend who looks out for us everywhere—Uncle Sam.

The Economic Value of Reflectors for Incandescent Street Lighting

By C. O. Baker.

In an article which appeared in the December issue of this publication the writer referred briefly to the economic value of the old standard 14-in. convex deflector as compared with the later types of flat, radially corrugated reflectors, 18 in. to 22 in. in diameter, which have been designed especially for street lighting with tungsten lamps. Since then correspondence which has passed before him from many of the smaller—and some even of the larger—lighting station operators, has shown such a preference for the former and less expensive reflectors as to indicate that the subject of increased efficiency through the use of suitable reflectors is but imperfectly understood.

This can readily be expected from stations whose limited revenues will not permit the retaining of skilled engineers, or whose executive officers are engaged in more absorbing commercial pursuits. And perhaps, too, the manufacturers of lighting accessories are at fault in issuing descriptive matter whose technical phrasing and polar candle power curves convey but scant intelligence to the average lay mind unfamiliar with methods of analysis.

Be that as it may, tungsten lamps under the later types of reflectors are proving an important factor in street lighting, especially in competition with gas and gasoline mantles, and any effort to set the facts before the prospective user in a convincing manner cannot come amiss.

The subjoined polar curves show the light distributed around:

(A) A bare 40 c.p. tungsten series lamp.

(B) The same lamp with a standard convex deflector.

(C) The same lamp with the later type tungsten street reflector.

It will be seen that there is a large volume of light radiated around the bare lamp above the horizontal, and it is the aim to divert as much of this as possible to a useful direction. The standard convex deflector does this to a certain extent, and it will be noted that the curve B shows a material increase in the zone between 120 degrees and zero; indeed, the curve B shows a wider distribution above the horizontal than the curve C. But in street lighting, with lamps suspended as they generally are 18 ft. or more above the street level, the light distributed above the horizontal is wholly ineffective. Further, with a lamp at this height a beam of light thrown at an angle of 75 degrees will meet the street level at about 70 ft. from the center, and at an angle of 80 degrees about 100 ft. from the center, while light distributed above 80 degrees will meet the street level at too great a distance from the light source to be of any illuminating

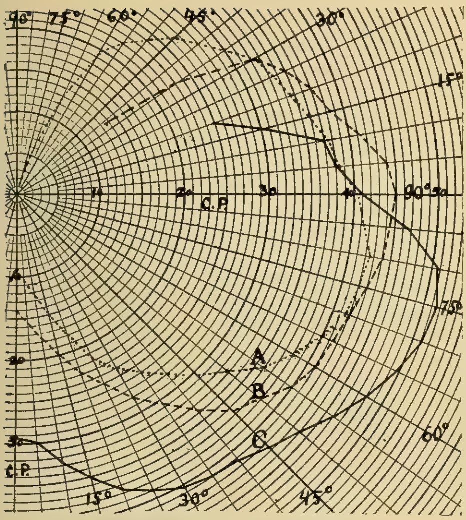


FIG. I.—POLAR CURVES.

value with a low unit of candle power. It is for this reason that manufacturers of the later types of tungsten street reflectors adjust the reflecting surfaces of these with relation to the filament so that their distribution curves show a maximum of candle power at angles between 70 degrees and 80 degrees, which curves from the standard convex deflectors do not.

Convenient methods of determining mean spherical and mean zonular candle power have been very ably described in previous issues of this publication by several writers, and those who have followed these articles closely can readily calculate the mean lower hemispherical candle power from the three curves given above, which will be found to be as follows:

(A) The bare lamp.....34.4 M. L. H. C.
(B) With the standard convex deflector ....37.8 M. L. H. C.
(C) With the newer type tungsten street reflector ....45.4 M. L. H. C.

Reduced to terms of percentages this means:

With B, the standard convex deflector, the mean lower hemispherical candle power of the bare lamp is increased 9.6 per cent., and with C, the newer type tungsten street reflector, it is increased 32.7 per cent.

Reduced to terms of efficiency in watts per (useful) candles this means that:

Where the bare lamp, A, which has an efficiency of 1.25 watts per mean horizontal candle, or 1.46 watts per M. L. H. C., the same lamp with B, the standard convex deflector, has an efficiency of 1.33 watts per M. L. H. C., as against 1.10 watts per M. L. H. C. for the lamp with C, the newer type tungsten street reflector.

This is the factor that has enabled some of the lighting stations in Boston, New York, Washington and other of the larger cities to compete with gas companies, and in many cases has warranted the expense of replacing the older standard convex deflector with the newest device designed expressly for use with tungsten series lamps.

In conclusion, as the above is written having in mind the busy man and the station operator unversed in the application of technical formulæ, the writer feels at liberty to remind the readers of this paper of Mr. Elliott's article in the January, 1909, issue bearing in part on the calculation of mean zonular candle power. As Mr. Elliott suggests, a set of tracings made after the manner described will be found very useful in calculating the average flux density, or mean zonular candle power, within certain angles shown on a light distribution curve, and serve as a ready means of comparing the economic value of various light sources.

Street Lighting Fixtures—Bracket Lamps

By H. Thurston Owens.

Coupled with the numerous discussions of street lighting problems, which are much in evidence in popular as well as technical literature, are statements concerning the dearth of attractive street lighting fixtures. Although in the majority of cases we may have to plead guilty to the indictment, considerable has been accomplished, as the illustrations testify.

Bracket lamps are largely used in Europe, but to only a small extent in this country, for more reasons than one. The most important is, that until quite recently little effort has been made to place

FIG. 1.

FIG. 2.

FIG. 3.

street lamps where they would prove of the greatest benefit; another is, that conditions in American streets are widely different from those found in European cities. In Europe the buildings are most uniform in character and usually of much lighter color, so that the reflection from buildings is of considerable importance. Furthermore, they have a much greater number of streets with extremely narrow sidewalks where posts would be out of the question.

The principal use of brackets in this country has been for ornamental purposes, and the lantern shown in Fig. 1 was probably erected with some such idea. The building is a police station, and the lantern sides are of green glass.

Where the sidewalks are given over to traffic, as well as the streets, the natural place for the lighting fixture is upon the building, as shown in Fig. 2. The building in this case is a railroad terminal, and the traffic would play havoc with a post, even if it were placed upon an aisle of safety.

The fixture shown in Fig. 3 is upon a building in one of New York's canyons, New Street, opposite the Stock Exchange. The reason for adopting this type of lamp support was not due to the close proximity of the "bulls and bears," but because the sidewalks are narrow, and also because the tenants did not object,—no small matter in this free country.

Somewhat similar conditions will be found in the case shown in Fig. 6. This unit lights the alley as well as the main street.

The use of brackets for trolley wires as well as lamps, Fig. 4, shows how they do it in Vevey, Switzerland; but needless to say, the principal item of interest in this picture was "maid in America."

When upright mantle gas lamps are used they must be placed quite near the ground in order to obtain the best lighting results. Curiously the height also determines the material which is most suitable for the fixture. The lamps shown in Figs. 5 and 7 are on one of the transverse roads in Central Park, New York, which connect Fifth and Eighth Avenues. In winter only a small snowfall will bring the roadway level with the sidewalk, and occasionally the truckmen prefer the latter. The brackets installed originally were made of cast iron, and are shown in Fig. 7. Owing to breakage from being struck by vehicles a simple fixture made of wrought iron pipe was designed, as

FIG. 4.

FIG. 5.

shown in Fig. 5, and thus far none have been destroyed from the same cause.

Another form of bracket which has been almost entirely overlooked here is the combination trolley and light poles. In the city of Denver, Colo., the problem of reducing the number of poles has been solved in this way, and merits consideration when changes in lighting systems are under way.

FIG. 6.

FIG. 7.

The "Perpetual" in Illumination

By L. Lodian.

The infallible Munchausen has related,—as illustrative of the severity of a Russian winter,—the instance of a lighted candle the flame of which could not be blown out. To extinguish it, the flame had to be broken off. The intense cold had "frozen the flame solid!"

* * *

Every science and every art, almost, has had, at some time or other, aims and aspirations of an impracticable and superstitious nature; every branch of learning has had its infatuated enthusiasts working at unachievable projects, and striving to reach unattainable ends. In mechanics, men of intellect have wasted their brain-power on perpetual motion; in mathematics, they have essayed the impossible squaring-of-the-circle (but circling-the-square is "another matter"); and the extraordinary delusions of the alchemists are a by-word. Their favorite and most enticing hobby was, of course, the transmutation of the common or base metals into gold and silver; many sought to make glass flexible and malleable; and still others tried to discover, or rediscover, the means of causing lamps to burn perpetually, as imagined to have been known to the ancients.

* * *

The belief in ever-burning lamps is not infrequently alluded to in prose and poetry, yet detailed and exact information on this point is to be had only by patient research. The referencing for the present much-condensed chapter, for example, has lasted through a dozen evenings, although the subject was known to the writer many years ago.

During the sixteenth and seventeenth centuries, a belief in the actual existence of ever-burning lamps seems to have been very real and widely prevailing. Many learned writers maintained that the ancients were acquainted with the preparation of a combustible fluid which, while burning and giving out light, diminished not in quantity and potency. Lamps supplied by this marvelous fluid were placed in tombs by the ancient Romans, and continued burning until some ruthless explorer desecrated the subterranean places of burial and allowed air to enter, whereupon the flame flickered and shortly expired. These wondrous lamps "burned the most brightly where there was most want of air, and were always extinguished by the immission of external air." (R. Plot, *Font filosofikum,* Oxford, 1685.)

To discover the secret of preparing this combustible yet inconsumable liquid was one of the alchemist's dreams: in their figurative language, they endeavored to "concentrate the four elements, and to make therefrom a wonder-working essence." The material upon which their operations were conducted, and in which they placed great reliance, was fine gold: this, they claimed,—resolved by hermetic methods into a clear liquid ("oil of gold"),—supplied by its incombustible oiliness, the "perpetual light." This nourished the ever-burning lamps, but was exceedingly costly. (Kristof Kriegsman, "Taaut," Frankfurt, 1665.)

* * *

The belief in perpetual lamps was sustained and diffused by the publication of many legends, which appear to have been freely accepted by the credulous people, notwithstanding their highly improbable character, and the slender basis of truth on which they were founded.

One of the most famous and oft-quoted legends establishing this superstitious belief was that of the tomb of Tuliola. One day, in the time of pope Paul the 3rd (1534-49),—he who convoked the concilio of Trent,—a tomb was opened at Rome which contained the body of a young woman whose flesh was still yet uncorrupted, and her tresses even were yet intact and bound with a band of chased gold. A burning lamp hanging in the vault was extinguished as soon as the air entered. On the walls was carved the inscription "*Tuliola filia mea,*" which was regarded as referring to Tuliola, the daughter of Cicero, whose death he la-

ments in his letters to Sulpicius. One authority states that the lamp burned several hours after opening the tomb, though it must have been closed more than 1500 years. This discovery was the subject of much comment.

* * *

Another perpetual lamp, which supplied partisans with one of their strongest arguments, was the lamp of Olibius. In the year 1510, some peasants, digging the earth to a considerable depth, near Padua, came across a tomb containing lighted lamps, one of silver and the other of gold; or, according to another source, there was but one lamp, placed in an urn betwixt two fials, one filled with liquid gold and the other with liquid silver, by virtue of which the light had been maintained since the time of the old Roman republic.

* * *

The famous chemist Glauber,—who has perpetuated his memory in the salts of that name,—over two-and-a-quarter centuries ago, writes of a lamp "which, being closed up in a glass, may be made to burn continually by its own virtue, and give light without any other help." He explains the admitted fact that when the "secret fire" is "touched by the least air, it extinguisheth and goeth out," by the suggestion that "the fire is appropriated to the elemental air," and "hath its own air in itself." (Glauber works, part 2, p. 216, anno 1689.)

When such a "shining light" of his day as the chemist Glauber writes thus, can it be marveled at that folks accepted the fact of perpetual-burning lamps as authentic? He goes on,—*re* the ever-lighted lamp,—"that this lamp may be very available to those who, through continual weakness, are forced to lay much upon their couches"; and that it may be "kept continually burning in their couch-chamber, not only because of its clear shining light which doth neither smoke nor scent, (like all other consumable lights),—which scent is very prejudicious to the ailing as well as to the well."

* * *

Many other equally credible narratives were current in the sixteenth and seventeenth centuries. At the time of the suppression of the monasteries in Britain by mandate of Henry 8th (1537), a tomb was opened containing a lamp which had been burning at least 1200 years. A monk named Kasodorus gives the information, with the declaration that he himself made perpetual lamps for the use of the monks in the monastery.

Reference is also made to the lamp of Palas, son of Evander, whose brave deeds were sung by Virgil. This lamp was found burning in a tomb at Rome, and must have burned over 2000 years.

Plutarch relates that Kleombrotos visited the temple of Jupiter and saw a lamp which the priests affirmed burned perpetually without oil. St. Augustin, writing of the lamp in the temple of Venus, states it "burned perpetually, and the flame adhered so strongly to the incombustible matter that neither wind, rain, nor tempests could extinguish it, though continually exposed to the inclemency of the seasons."

* * *

Trithemis, a learned abbot of the fifteenth century, gives written instructions for the making of the oil and wick of the ever-burning lamps. The materials are simple, obtainable to-day in any town in America, and the lamp, "when kindled, will burn with a perpetual flame." It would be a waste of space to devote about a column to copying this "recipe": suffice it to say, the process would prove very unsatisfactory to any curious investigator. The abbot can only be excused for his misleading formula by our remembering that in this time, practice was never thought of to combat theory ("theory proposes, practice disposes"). His lamp "theology" was not to be tempered by the science of practice.

* * *

In the Manhattan public library is a big Latin work, profusely illustrated, of the date 1652, written expressly by the divine Fortunatus Licetus, to prove the truth of the circumstances anent perpetual lamps. The volume is lavishly decorated with engravings of the eternal-burning *lucernis* (lamps). It is a notable example of misplaced erudition and credulity. The reverend divine has admitted to his pages pictures of lamps highly suggestive of the

state of morals—or lack of them—of the epoch, and upon which a very interesting work could even be written to-day on "The Profane in Illumination,"—inadmissible in the pages of a general magazine, but meet in a technical publication for the illuminating engineer,—just as sanitary and medical journals discuss and illustrate subjects inadmissible to the pages of general periodicals.

* * *

Many endeavors have been made by modern authors to account for this persistence in the belief of eternal lamps. Burning lamps, it is known, were placed in tombs by the ancients; and these same lamps—of course extinguished long, long ages ago, possibly even within a couple of days after sealing the mausoleum—would naturally be noted on unearthing and opening up the vaults after the repose of centuries—Says the French scientist, Marville: "It happens frequently even to-day, when antiquarians are searching by torch-light old sepulchers which they have opened, that thick fat and gross vapors engendered by the corruption of dead bodies, have momentarily flashed into flame, to the great astonishment of the searchers, who were ignorant of the cause. The presence of the ancient extinguished lamps would, of course, aid the delusion."

* * *

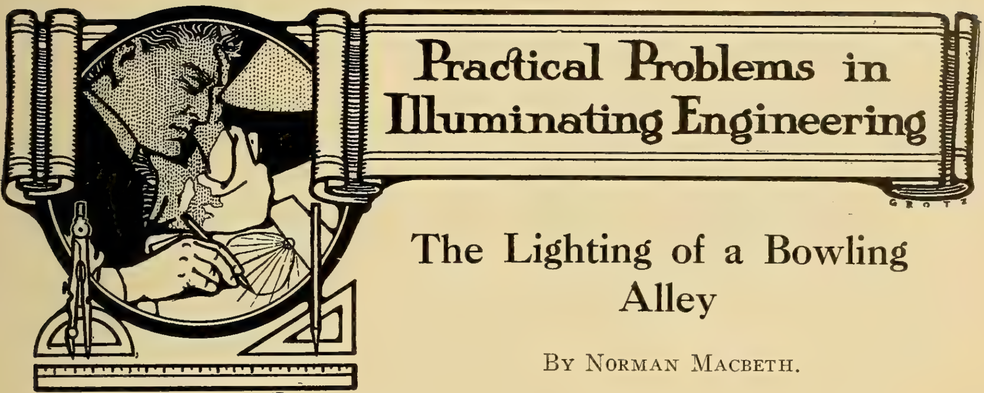
The writer owes his indebtedness for the threadwork of this paper to referencing to some thirty fascicules which have appeared on the subject during the past couple of centuries, and earlier.

The Decorative Effect of Electric Signs

There are a few cities and towns which have not as yet recognized the difference between the truly decorative appearance of even the plainest electric sign and the possibilities for ugliness of the old time bill-board. Obstructive ordinances, in some cases which practically eliminate the electric sign altogether, are still occasionally to be found in force. Such obstructions are entirely out of keeping with the spirit of the times, and have no justification from either practical or sentimental considerations. The electric sign differs from all other public placards in being, from the very essentials of its existence, decorative when in use. A light is fascinating in itself, and, like the lily, does not need to be painted. No matter what form it takes, the gleaming of a luminous body at night produces a cheerful and pleasant effect. The simplest form of the electric sign, consisting merely of letters outlined in lamps, is, therefore, a decorative object. The possibilities of elaborating this decorative effect by the use of color and movement are limitless.

The fact that there is not a type of building or vocation that does not use the electric sign should be convincing proof of its fundamental value and universal fitness. It is displayed alike by the church, the free library, the bank, the theater, the hotel, and the mercantile establishment. Nothing gives greater life and attractiveness to a town at night than a display of electric signs, and *per contra,* no town appears so dead and deserted as the one in which the lights are dim and the signs wanting.

Instead of obstructing by troublesome ordinances, city authorities should everywhere offer every reasonable inducement for the construction of such signs. This, of course, does not mean that careless and unworkmanlike practice should be permitted in their construction, any more than in the erection of buildings or bridges; but it is a very simple matter to so regulate as to secure absolute safety to the public without unduly hampering this exceedingly important and valuable attraction to the city.



The Lighting of a Bowling Alley

BY NORMAN MACBETH.

In considering the proper illumination for bowling alleys, it would appear that it is important to have an intensity of illumination which is fairly uniform, beginning with comparatively low values at the runway up to the foul line, it being merely necessary to discern comparatively large objects, having sufficient illumination to enable the bowler to readily discern differences in balls, also the floor arrangements.

From this point the intensity should be gradually built up to a point where finally the illumination on the pins is such that the eye can easily and definitely fix the exact position of each pin, and that the bowler may with ease and comfort be enabled to see each and every pin strongly outlined and fully defined against the background at the rear of the pit.

To prove that this is the condition desired it is only necessary to conceive a lighting effect in conjunction with a rearrangement of the colors in the background, a reduction in the intensity effective on the pins, the building up of the illumination at the foul line from light-sources of high intrinsic brilliancy in-

FIG. I.—BOWLING ALLEY LIGHTED WITH INVERTED GAS LAMPS.

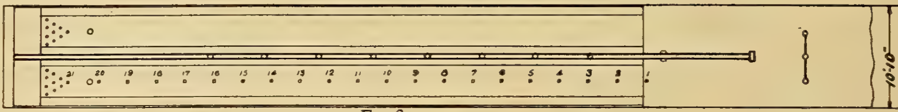


Fig. 2

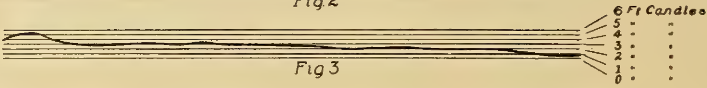


Fig 3

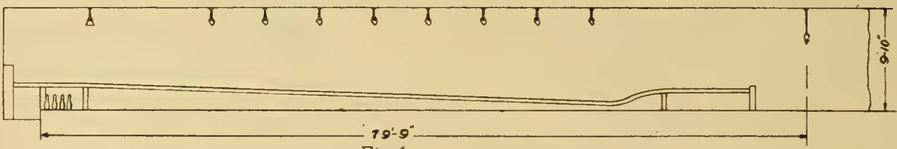


Fig 4.

stalled in the line of vision. In this way it would be possible to illuminate an alley so unsatisfactorily that the bowler to know that the pins were set up would have to walk down the alley to a point where he could observe them closely.

In Fig. 1 is shown a photograph of alleys which are well lighted, and which in practically all respects meet the ideal conditions specified. These alleys are in the basement of the Medico-Chirurgical Club, 1609 Arch street, Philadelphia. This work was installed over a year ago, and as the effects have been extremely satisfactory, the following data and measurements were taken for the purpose of determining just what conditions contributed to the proper lighting of bowling alleys.

In Fig. 2 is shown a plan of the alleys, giving position of outlets, also test stations, 21 of which were located down the center of the left hand alley at distances 3 feet apart. Measurements were taken on the floor at the points designated. A piece of opal glass having the uppermost surface ground was placed on the floor at these points, and the brightness of same measured with a Sharp-Miller photometer, using the mirror in the horn and the open diaphragm, the photometer being placed on a tripod at the convenient hight of approximately 3 feet. By a substitution method of measurement, the values secured with the photometer and the diffusing glass were converted directly into foot-candles, and the photometer was afterward standardized against a bar photometer by the same operator. The results are shown by the tables following, and also graphically by the illumination curve, Fig. 3.

It may be noted that these values beginning at .67 foot-candles gradually increased up to 5.45 foot-candles at the pins.

In Fig. 4 is shown an elevation of the alleys, giving detail of the arrangement of the lamps and their relative positions. In Fig. 5 is given a diagram for explanation of vertical measurements taken on the positions occupied by the pins. The screen of the illumination is set normal to a plane 6 degrees above a horizontal plane 9 inches high and parallel to the bed of the alleys, this being the vertical plane which it was concluded would be most effective on the eyes of the bowler at a hight of 5 feet and at the point from which delivery of ball is made, approximately 60 feet distant.

Fig. 6 shows the inverted mantle burner used equipped with a green, white lined, angle shade and Fig. 7 is the polar diagram of the vertical distribution of the light from this combination. Eight inverted burners similar to Fig. 6 were used

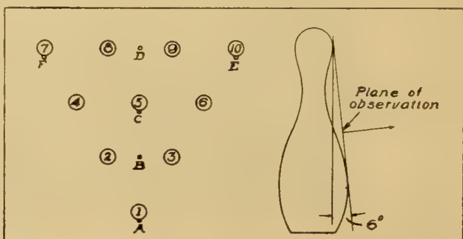


Fig 5

FIG. 6.—TYPE OF INVERTED GAS LAMP USED.

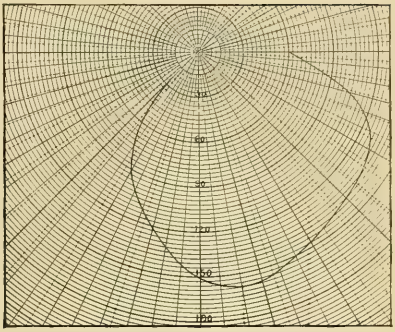


FIG. 7.—POLAR DIAGRAM OF VERTICAL DISTRIBUTION OF LIGHT FROM INVERTED GAS LAMP WITH ANGLE SHADE.

down the center, between the alleys, as shown in Figs. 1, 2 and 4, at a height of 8 feet 4 inches from floor to center of mantle, the distance from the ceiling to center of mantle being 18 inches. At a point slightly forward of the head pin a single inverted burner is installed over the center of each alley. These burners are equipped with opal cone concentrating reflectors and at the spectators' end of the alleys a two light fixture was installed to furnish special illumination for the score board and general illumination for that end of the room.

As stated above, this installation has been in use over a year and is being maintained by the man in charge of the alleys. It is quite likely that the results given below would have been high, if these burners were under the care of a regular maintenance company who clean the glassware regularly and furnish sufficient mantles to keep the burner efficiency at a maximum.

The lamp at station 9 was improperly adjusted, as may be seen by the drop in the illumination at this point. This drop is, of course, simply a measureable one, and not one which could be observed by ordinary examination of the alleys.

DATA PERTAINING TO THE PROBLEM OF ILLUMINATION.

Dimensions of room, 85 feet x 10 feet 10 inches.

Height of ceiling, 9 feet 10 inches.

Height of mantles, 8 feet 4 inches.

Height of test plane, 0.1 inch.

Number of burners, 12.

Average consumption of burners (cu. ft.), 3.3.

Number of test stations, 21.

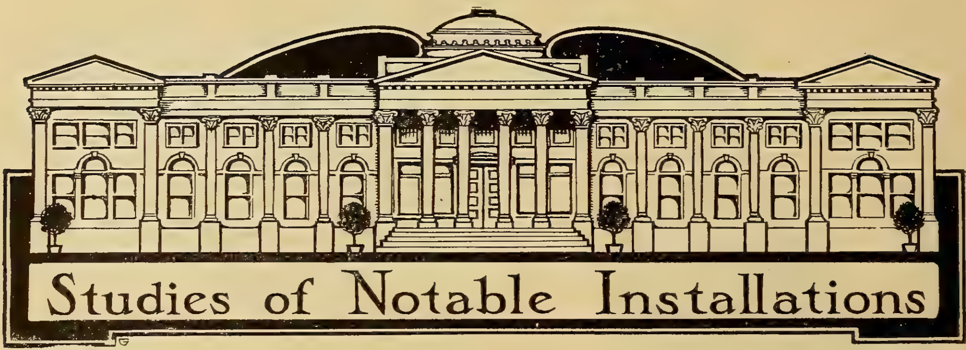
OBSERVE HORIZONTAL ILLUMINATION VALUES.

Stations.	Foot-candles.	Stations.	Foot-candles.	Stations.	Foot-candles
1	.72	8	2.3	15	2.87
2	.67	9	2.21	16	3.07
3	1.22	10	2.96	17	2.78
4	2.12	11	2.4	18	2.67
5	2.2	12	2.88	19	3.2
6	2.23	13	2.67	20	5.45
7	2.45	14	3.2	21	3.84

OBSERVE VERTICAL ILLUMINATION VALUES AT PINS.

Stations.	Foot-candles.
A	3.26
B	3.28
C	3.28
D	3.25
E	3.5
F	3.1

Owing to the fact that it is necessary, in addition to the illumination on the floor, to properly and uniformly illuminate the walls and ceiling of a room of this character, a statement of lumens effective on the horizontal plane could not be used as a basis for the determination of the efficiency of the installation. Under the best conditions of gas and adjustment, this inverted burner will generate over 400 lumens in the zone 0 degrees to 60 degrees, and with average gas and adjustment conditions, an average of 300 lumens effective is easily possible in large rooms with dark walls. Twenty per cent. to 25 per cent. is, therefore, a very liberal allowance for a regular pressure and average conditions of adjustment.



Maxine Elliott's Theater, New York

The theater, being the home of unrealities and make-believe, has generally shown the influence of artificiality in its architecture and decoration. The word gorgeous has been generally selected as the most complimentary term that could be applied to the appearance of a playhouse. But the drama at its best is by no means essentially spectacular; and in a metropolis, where a theater can cater to a particular class of patronage, it may select its line of attractions and adapt itself, both body and spirit, to the particular phase of the dramatic art which it wishes to stand for.

Maxine Elliott's Theater in New York has several distinctive features. To begin with, it is the first of New York's many theaters to be named from an actress. Its exterior architecture is distinctive, being severely classical, both in treatment and in material. Its white marble façade is a delight to the eye. The entrance to the ground floor, or pit, is on the street level, thus bringing the balcony and gallery within correspondingly easy reach.

The one word that most fully describes the interior is "cozy"; there is nothing of theatrical gorgeousness or the spectacular about it. From the restful olive green carpet and upholstery to the plain buff tint of the ceiling, everything is suggestive of comfort, refinement and genuineness. The decorative treatment is distinctly of the Louis XVI. period. The side walls and ceiling are in the same warm buff tint, the decorations being entirely confined to carving and stucco.

The illumination follows the spirit of the period which it represents with true fidelity. There is the one central "luster" suspended from the center of the ceiling, as shown in Fig. 1. This contains carbon filament lamps, with bulbs stained pale amber, so as to give a mellow light to harmonize with the tinting of the walls. The lamps do not show as plainly to the eye through the festoons of crystals as appears in the photograph. The effect of candles is carried out around the central band of the fixture, pointed candelabra lamps being used for the purpose. Sconces, or side brackets, holding two imitation candles, are used around the side walls, and also under the balconies. These are of dull gold finish, eight candle power candelabra lamps being used. A screen of light buff silk is placed in front of each lamp. The general effect of this illumination is restful, homelike and artistic to the highest degree. Small three-light clusters were placed on the ceiling under the balconies for additional illumination, but it has been found unnecessary to use them.

The lighting of the foyer is entirely by the candelabra brackets, as shown in Fig. 2. The vestibule is in white marble, and is lighted with lanterns adapted from similar fixtures in the Grand Trianon. The brackets on either side of the box office are modern adaptations.

From the point of view of efficiency much fault can be found with this installation, but as a piece of decorative and pleasing illumination it is difficult to conceive of a more satisfactory example.

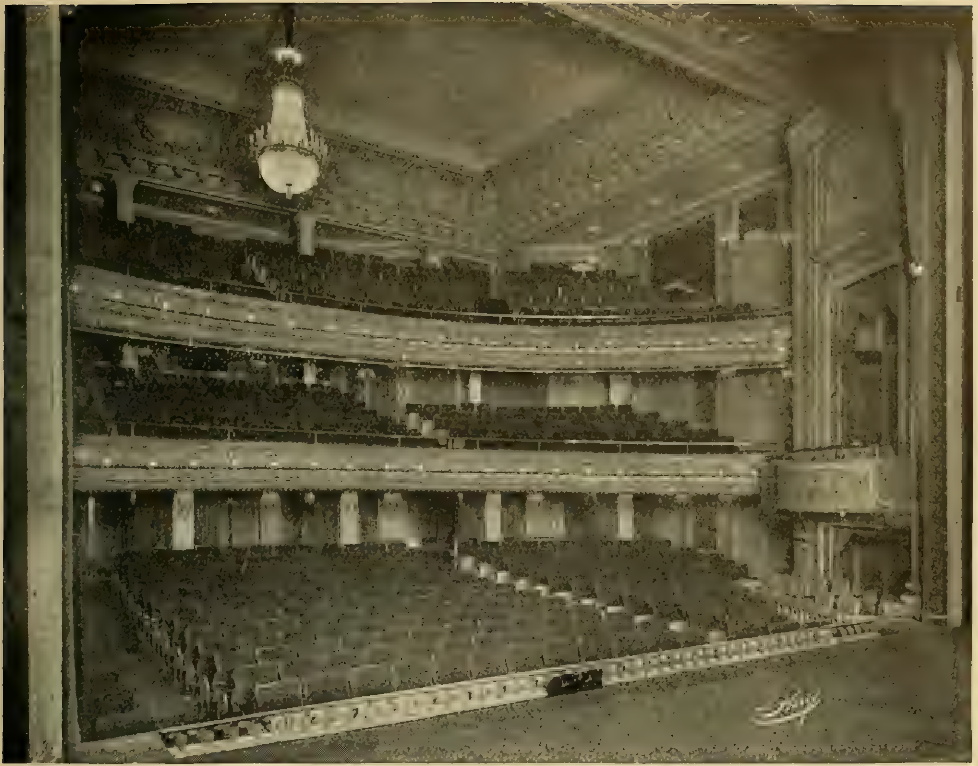


FIG. 1.—AUDITORIUM.

FIG. 2.—FOYER.

FIG. 3.—VESTIBULE.

If we wish to keep strictly within the lines of technology we might say that its artistic efficiency is 100 per cent., and its hygienic efficiency, as measured by the pleasing effect upon the senses, substantially the same; and all illuminating engineers worthy of the title are perfectly willing to admit that there are plenty of cases in which these two efficiencies are of greater importance than the efficiency expressed in lumens per watt.

The generally pleasing effect of the lighting installation and interior decorations of this playhouse suggests a principle having universal application, and that is the mingled sense of surprise, delight and relief which is produced by a frank, but judicious, variation from the conventional. It is always an interesting study for those reflectively inclined to observe to what extent both our labors and our pleasures are governed by precedent and usage; and the field of illumination is quite as much in bondage to this influence as the domain of politics, religion or social customs. There is a point beyond which we evidently may not transgress against custom, although examples are by no means wanting of outline lighting in the church comparable in spectacular effects with that used on "automatic" theaters, and of saloons whose furnishings and lighting are in the most vivid contrast to the traditional gloom of those precincts to which it is supposed to be the vestibule.

To come to a more apposite application of our theory: there is no special reason why the interior of a playhouse should have the trade-marks of its profession blazened on every hand. Why should it not be made to give the effect of a private parlor or drawing room furnished with exquisite rather than gaudy taste, and lighted to harmonize with this general effect? We can fancy the distinguished actress whose name appears over the entrance of this theater propounding this question to her architect, and receiving as an answer this beautiful edifice.

Fixtures and Accessories

Ceiling Fixtures

The incandescent electric lamp revolutionized the construction of fixtures. The fact that it can be used in any position and in any location made possible a number of adaptations that were absolutely impossible with flame light-sources. One of the most important of these is what is generally known in this country as the "ceiling fixture." If we wish to be exact in defining this type of fixture we may include all fixtures in which the lamp holder is attached directly to the ceiling, i. e., without a definite supporting element, such as a tube or chain.

The simplest form of ceiling fixture, if it can be called a fixture at all, is the single lamp socket with a rosette of stucco about it. While this method of lighting is not common, it has been used to some extent; a notable case is that of the City Hall, Newark, N. J., which was described in the November, 1906, issue of THE ILLUMINATING ENGINEER. The Public Library in Columbus, Ohio, as originally laid out, used this method of lighting; and a somewhat elaborate installation of the same type may be found in the Hotel Marlborough-Blenheim, Atlantic City, described in the July, 1906, issue.

The simplest form of a distinctive fixture, however, is that generally known as the "ceiling bowl," which consists usually of an approximately hemispherical glass bowl attached to the ceiling by a spun metal ring. Such a fixture naturally suggests itself for low ceilings, and is also frequently used in halls and corridors where it is desired to leave an unobstructed view.

In the days before illuminating engi-

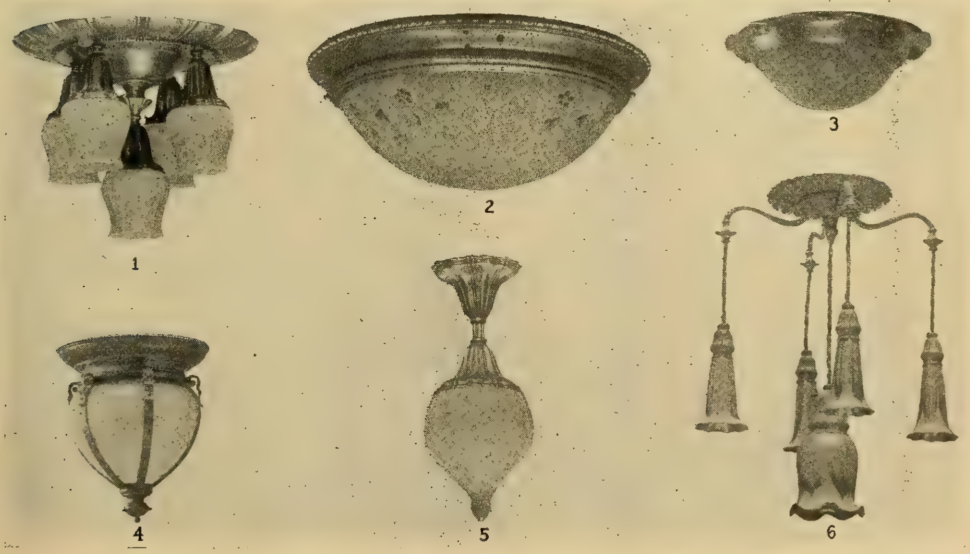


FIG. I.—SOME AMERICAN EXAMPLES.

neering the bowl fixture usually contained a cluster of 16 candle power lamps in a horizontal position, or nearly so, and without any reflector back of them, and a frosted or opalescent glass bowl. As will readily be conceived, such an arrangement had a very low efficiency. The absorption of light by the glass, and the small amount of reflection from above was serious to begin with, and the lamps being hidden from view and usually difficult of access, there was a strong tendency to allow the lamps to burn long after their useful life had been passed, and the globe and lamps to accumulate dust to an unlimited extent.

The plain hemispherical bowl and spun brass ring are furthermore hopelessly inartistic; it is impossible to get away from the suggestion of the wash basin or dishpan. It is interesting and curious, however, to observe how readily this inartistic feeling may be removed by the use of less familiar outlines. Thus, if instead of using the hemisphere or other part of a sphere for the bowl, an outline with which the eye is less familiar, such as a parabola, be taken, the form at once becomes pleasing. This fact brings out a well established principle in the science of esthetics, viz., in order to produce the impression of beauty the mind must not be able to instantly resolve and classify the objects seen. The circle is the simplest of all curved lines, as well as the most familiar, and therefore is instantly

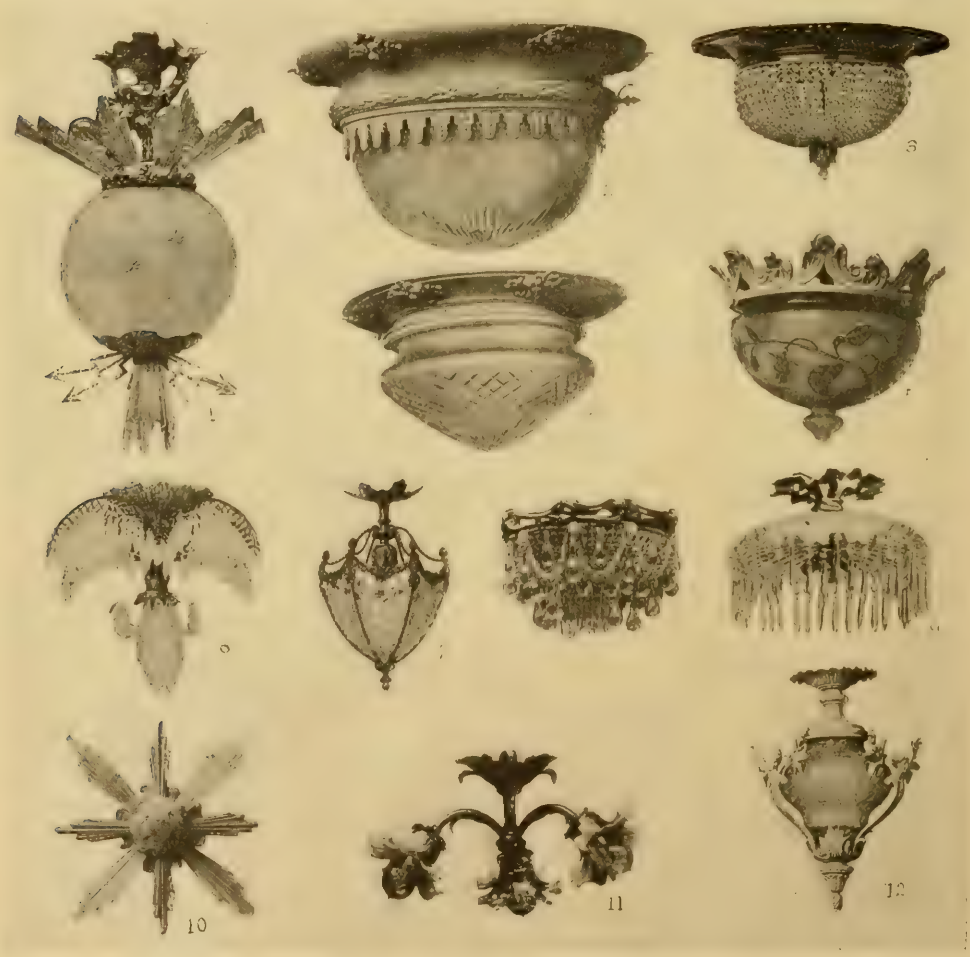


FIG. 2.—SOME FOREIGN EXAMPLES.

FIG. 3.

recognized as such by the eye, while the parabola and ellipse, being unfamiliar, are not thus readily classified, and hence give opportunity for that contemplation which is the essence of the esthetic feeling.

A study of the examples given in Fig. 1 will show that this principle is preserved in every case. Thus, No. 3 is entirely without any adventitious ornamentation, but the variation of the curves from the simple forms gives a distinct artistic quality to the fixture; and in No. 2, in which superficial decoration is used to a limited extent, the chief element of beauty is in the contour. No. 4 brings out the same principle by the use of slightly more complicated curves. Substitute a sphere in place of the compound curvature of the globe used, and the fixture would lose all its artistic merit.

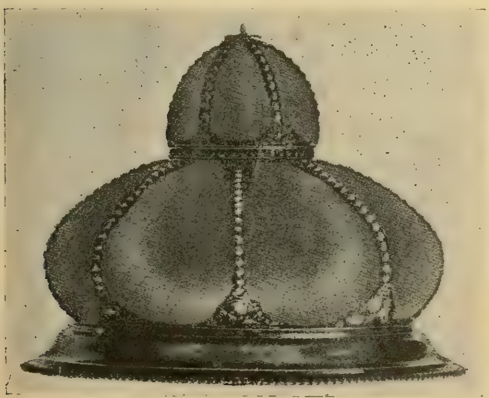


FIG. 4.

No. 5 is a still further elaboration of the same principle; not only is the contour made up of regular, but unfamiliar, curves, but the perspective is also varied in a similar manner. The harmony between the glass globe and the metal support furnishes an example of an essentially artistic construction resulting from beauty of line only, exclusive of any superficial decoration. No. 5 is a still further development of the principle, in which the grace of outline and of perspective is repeated in such a manner as not to be confusing. No. 6, while depending largely upon the same principle, brings in a further element of applied art by suggesting forms of natural beauty; in this case the glassware, both in color and contour, suggesting, though not absolutely imitating, the forms of flowers, the supports themselves carrying out the idea by simulating drooping stems.

Fig. 4 illustrates still another variation of the principle of compound curves, and undoubtedly uses the beauty of color ef-

fects in the translucent glass to add to the general effect.

Fig. 3, on the other hand, is a complete departure from this elementary principle, and depends for its artistic feeling entirely upon its simulation of natural forms. The only criticism in this case is that a vegetable growth which this represents would naturally be supported from below instead of above. The fixture, therefore, would be more effective for a new post.

Fig. 2 shows a variety of effects depending upon various principles for their artistic feeling. In No. 1 the glass prisms radiating from the top of the globe, with lamps placed behind them, suggest the radial beams of light which are produced by broken clouds and sunlight. The metal lightning at the bottom, however, is a decidedly archaic form of symbolism, and the fixtures as a whole are rather conglomerate. Perhaps the best that can said of No. 2 is that it is of the Louis XVI. period. Nos. 3 and 4 are ascribed to the same period of decoration by the manufacturers, although the spirit of this particular school is far less apparent. Their real claims to beauty are in their variation from the simple curves and in the superficial decoration. No. 5 is of the Art Nouveau type. It may be remarked here that whereas an object may rest upon three or more points when supported at the base, when supported from above the eye requires that the means of its attachment, or at least the opportunity for such means, be readily apparent. This has been the case in all of the examples previously referred to, but does not quite hold in No. 5. In actual fact the fixture is supported in the center, but this support is invisible when the fixture is in place, and as it is neither apparently nor actually attached by the points of visible contact around the metal crown, there is somewhat the same feeling on looking at it that there is in watching the circus performer walk with his feet on the ceiling; while he is apparently walking as naturally as upon the floor, we know that he must be using some unseen trick of attaching his feet to the ceiling. No. 6 is a fairly successful attempt at utilizing the artistic effect of drooping branches, the central support offering a natural attachment for the branch-like elements. The inverted flower in the center is the only incongruous feature. No. 7 is graceful in outline, logical in construction and artistic from the extreme delicacy of the flower-like glass and metal decorations. No. 8 suggests the exquisite beauty of natural stalactite and crystalline formations, enhanced by the brilliancy of the reflector light and limpid translucency. The metal support classed as Louis XV. is open to the criticism made in reference to No. 5. No. 9 is a simple construction depending for its beauty upon prismatic reflection and color. No. 10 is a form of ceiling fixture commonly called a "sunburst," the rays of light being suggested by the radiating prisms. This type of fixture is always effective when glass prisms are used; but, strange to relate, metal is sometimes substituted for glass, with the result, of course, that the whole thing becomes simply grotesque. No. 11 is another attempt to utilize flower-like forms and lines, but encounters the difficulty of the support from above instead of below as in nature. No. 12 purports to be of the Louis XVI. period; and to ascribe any lighting fixture to one of the French periods seems to be sufficient justification for its existence in the eyes of the average layman. The delicately sculptured metal work, while beautiful in itself, is too finely wrought to be placed so far away from the eye of the beholder as is necessary in a lighting fixture, and is furthermore purely adventitious, having no structural purpose, real or apparent. The form of the globe also is rather suggestive of a vase, and should therefore rest upon a support from below rather than be hanging from above.

Generally speaking, an analysis of the examples given will show that however skillful the workmanship, or cunning the simulation of natural forms of beauty, the elementary principles of esthetics can no more be defied in art than can the laws of dynamics be neglected by the mechanic.

Theory and Technology

Plain Talks on Illuminating Engineering

By E. L. Elliott.

XX.—EXTERIOR LIGHTING. DISTRIBUTION OF LIGHT.

We discussed in the previous issue the three different methods of measuring street illumination, or rather the three bases upon which measurements may be made, and showed how widely the values would differ with the same conditions of light under the three different measurements. In all problems and contracts, therefore, in which the actual intensity of illumination is made use of, care should be taken to specify which of the three bases of measurement are used.

The most obvious fact in regard to all street illumination is the unevenness of the distribution; in other words, the difference between the lightest and darkest portions of the street. The cause for this apparent defect will readily appear from a little simple mathematical consideration of the subject. The statement that the intensity of illumination on a given surface depends upon the amount of light falling upon the surface is easy to understand. Intensity of illumination may thus be compared to depth of water. For a given volume of water, the larger the

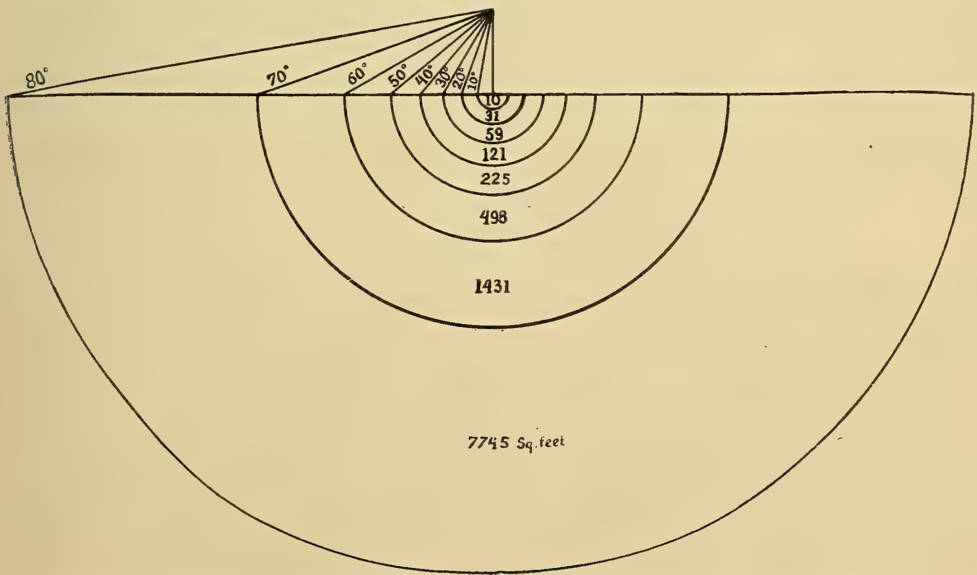


FIG. I.—SHOWING THE NUMBER OF SQUARE FEET OF SURFACE COVERED BY LIGHT GIVEN OUT WITHIN ANGLES OF 10° AND THE NUMBER OF LIGHT UNITS FALLING ON EACH SPACE FROM A LIGHT SOURCE PLACED 10 FEET ABOVE THE PAVEMENT.

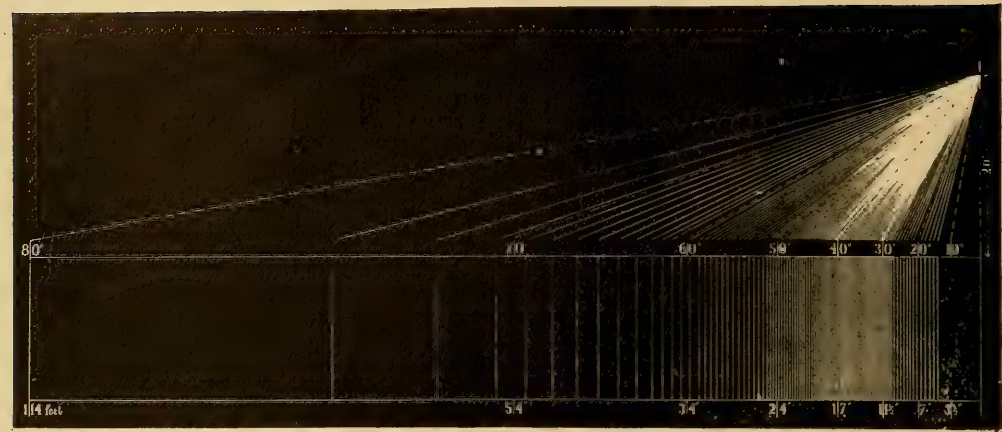


FIG. 2.

surface over which it is spread the shallower will it be. The same holds mathematically true with light; intensity is merely a question of the ratio between the amount of surface, and the amount of rays which cover it.

Fig. 1 shows the relative amounts of space covered by the light emitted within angles of 10 degrees from a light placed 10 feet high. This brings out the enormous increase in space covered by the rays as we recede from the point directly underneath the light source. While there are only 10 sq. ft. covered by the rays falling within 10 degrees of the vertical, the rays between 70 degrees and 80 degrees cover 7745 sq. ft., or 774½ times as much surface. In other words, to produce the same horizontal intensity of illumination there would have to be 774½ times as much light given out within the angle from 70 degrees to 80 degrees as given out in the angle 10 degrees from the vertical. This simple illustration will at once show the practical impossibility of securing anything like uniform illumination in the ordinary cases of street lighting. Only in the comparatively small number of cases which properly come under the head of spectacular lighting is even approximate uniformity to be expected. The real problem to be considered is therefore concerned with the minimum illumination, i. e., the darkest part of the street, and the maximum, or lightest part. The latter question is only of economical importance. In no case is the actual illumination on the pavement sufficiently intense to be in itself glaring; it may be many times brighter than necessary for the purpose, but the excessive brilliancy is merely a waste of light, and not a positive fault, except in so far as it may make the darker portions appear still darker by contrast. The really important question in distribution is, therefore, that of minimum illumination and it is this that distinguishes, as we set forth in a previous article, street illumination proper from beacon lighting. If the darkest part of the street is sufficiently lighted comparatively little heed may be given to the brightest part. Of course, too great contrasts are objectionable, and the greater the approximation to uniformity the better; but, as we shall see, complete uniformity with any practical means now at hand can be obtained only by the use of so high a general intensity that it would be economically out of the question for general purposes.

The calculation of the illumination upon a pavement from a given light-source is a problem that is of far more than purely technical interest. The commercial rating of a lamp in candle power, or its rate of consumption of electric current or gas, gives very little information as to the results which it will give in use. When the arc lamp first began to be used for street lighting it was common to rate the larger size lamp as a "2000 candle power arc," and the very sound of the expression "2000 candle power" un-

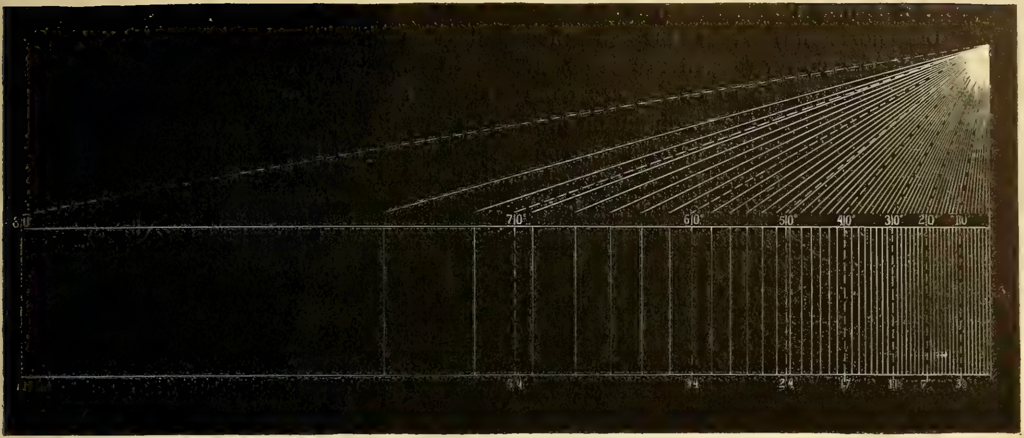


FIG. 3.—DISTRIBUTION AND HORIZONTAL INTENSITIES OF SO-CALLED "2,000 C.P. OPEN ARC LAMP" FITTED WITH OPAL GLOBE.

doubtedly persuaded many that the resulting illumination would be correspondingly large. Although this form of lamp has practically become obsolete, it will be interesting to observe the resulting illumination on the pavement. This may be shown by a graphic method which the writer used some eleven years ago. This method gives a more definite idea of the actual illumination than the ordinary method which uses simply a curve. The relative amounts of light falling within the different zones, or angles, are represented by lines of uniform width, each line representing a unit of light. By using white lines on a black back-ground the shading produced gives a fair representation of the degree of illumination. In some respects this method is more reliable than even a photograph, on account of the photographic action of light being different from its visual action.

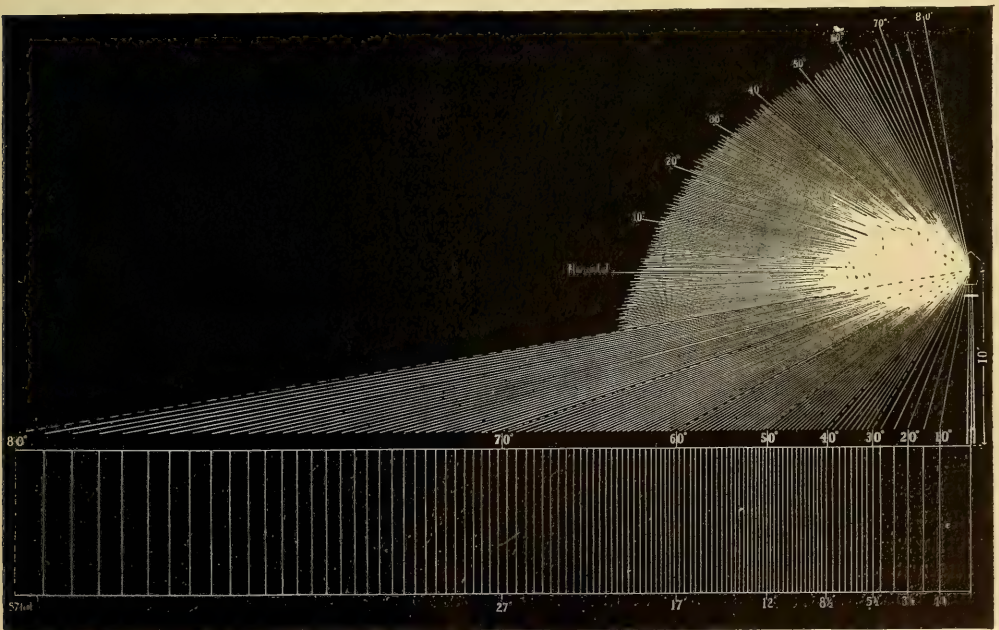


FIG. 4.—DISTRIBUTION AND ILLUMINATION FROM A BARE UPRIGHT MANTLE GAS BURNER.

Fig. 2 shows the distribution of light on the horizontal from the so-called "2000 candle power" open arc lamp, at the various angles up to 80 degrees from the vertical, and also the illumination produced by this distribution upon a horizontal plane. Fig. 3 shows the distribution and horizontal intensities of such a lamp fitted with an opal globe, and Fig. 4 the distribution and illumination from a bare upright mantle gas burner. It must be remembered, however, that in the latter case the value is relative, i. e., it has been drawn on a different scale and must not therefore be compared with the arc lamp diagram for actual illumination.

In connection with the inequalities of street illumination as produced by the various light-sources, the large proportion of waste light is the most striking feature. It is, of course, at once apparent that all the light given out above the horizontal, or level of the lamp, is entirely wasted. A little consideration of the simple mathematics of the problem will also show that, so far as the illumination of the pavement is concerned, all light given out above the angle 20 degrees below the horizontal is likewise useless.

A Tungsten Comparison Lamp in the Photometry of Carbon Lamps

By Herbert E. Ives and L. R. Woodhull

In the photometry of incandescent lamps the substitution method is commonly used. That is, the lamp measured is not compared directly with a standard, but with a "comparison lamp," which is carefully calibrated against a candle power standard or standards at the beginning of a run, and at frequent intervals. This method is adopted not only to obtain the greater accuracy of a substitution method, but to avoid operating a valuable standard continuously, with consequent comparatively rapid change in its value. After the standard check, the results of the measurement depend entirely upon the correctness and constancy of the comparison lamp. Since, however, the comparison lamp is subject to the changes inherent in the type of filament, it is necessary with carbon lamps to use only seasoned ones, and to keep close watch on their candle power by checking with standards.

Some time ago Professor Rosa, who is in charge of the photometric work of the Bureau of Standards, Washington, D. C., requested us to try a tungsten lamp, operated at voltages to give carbon lamp colors, as a comparison lamp in the testing of carbon filament lamps. The object in view was to obtain a long lived and constant comparison light which at the same time would give perfect color match with all types of carbon lamps. It was expected that this would be found the case with the tungsten lamp, because, first, the candle power changes with this filament are small during life, even at rated voltage; secondly, the life of all glow lamps is greatly increased at high watts per candle, and the tungsten lamp matches the carbon lamps in color at efficiencies near three watts per mean horizontal candle, or two and one-half times the normal rating of 1.25 watts per candle. If the relationship holding between watts per candle and life for carbon lamps is approximately true for the tungsten as well, this means an increase in life of at least twenty times. Consequently the qualities of longevity and constancy could be predicted. The further advantage of color match is of great importance where accurate photometric work is required. Concordant readings by different observers cannot be expected where a color difference exists in the light measured. In the commercial work of the Bureau of Standards separate standards for 3.5 watts per mean horizontal candle power and 3.1 watts per candle are used. The values of these are the means of readings made against the primary 4 watts standards by all the members of the photometric section. With lamps of each efficiency, the appropriate standards and appropriate comparison lamp color are used. In this way the color difference difficulty is eliminated, except in the preparation of the

standards, where it is met by securing once for all the mean and most probable value obtainable. Since the tungsten lamp at low voltages will match either 2.5, 3.1, 3.5, or 4 watts per candle color it lends itself well to this plan.

Two months' experience with the tungsten comparison lamp has shown it to fully equal expectations, and to be much superior for the purpose to carbon lamps.

The details of installation are here given as a guide to any who may desire to duplicate the arrangement. An 80 watt-120 volt lamp was taken, and the voltage determined experimentally, at which it gave the same color as 4, 3.5, 3.1 and 2.5 (Gem) watts per candle lamps. These voltages were 79, 84, 87 and 97, respectively, corresponding approximately to 4.5, 3.7, 3.4 and 2.6 watts per mean spherical candle. Obviously the candle power varied greatly for these different voltages. With a candle power scale, as used on the Bureau of Standards' commercial photometer, it is necessary to have the comparison lamp accurately 16 candle power. A means to accomplish this with the tungsten lamp was imperative, and was found in the use of diaphragms, since the candle power of the 80 watt lamp at all colors was greater than 16. It was impossible to place the diaphragms before the lamp itself since the distance of the diaphragm from the center of radiation, due to the size of the bulb, would permit an error of 3 per cent. in the candle power readings at the ends of the scale. Two means of overcoming this difficulty presented themselves. First, an image of the flame could be formed by a lens or concave mirror, and the image diaphragmed. Secondly, a ground glass screen could be placed in front of the lamp, and the diaphragms placed over this. The latter plan was adopted as most convenient, although it was then necessary to back the lamp with a mirror to secure sufficient light. With a larger lamp the mirror would be unnecessary. Lamp, mirror and ground glass screen were mounted together on a stand, the ground glass being held in a groove wide enough to receive the several diaphragms which cut down the light to very closely 16 candle power for each color. These diaphragms vary from two to three and one-half inches square, and are all small enough so that the error due to considering the glass surface as a point source is negligible.

In order to set the lamp to give exactly 16 candle power, the same procedure was adopted as in the Bureau's work with carbon lamps. The voltage is adjusted by trial (or by knowledge from previous work) to give very nearly the correct candle power reading. Then a number of standards are read, and from the main deviation of the readings from the standard's true values the change in voltage which will give the correct reading is calculated. For carbon lamps (3.5 watts per candle) the percentage change is given by the relation $\left(\frac{V_2}{V_1}\right)^{5.6} = \frac{cp_2}{cp_1}$ or in the differential form, $5.6\, dV = d\,(cp)$. In order to follow the same plan with the tungsten lamp, it was necessary to know the voltage candle power relation at the efficiencies used. This was obtained from data given by Mr. F. E. Cady,* from which it follows that from 2.6 to 4.5 watts per mean spherical candle the voltage exponent ranges from 3.8 to 4; the relationship to use is therefore $3.9\, dV = d\,(cp)$. By the use of this relation (actual numerical values are kept tabulated on the photometer table) the comparison voltage is accurately fixed.

Because of the comparatively low voltage of the tungsten lamp it has been found convenient to place in series with it an adjustable rheostat, and measure voltage across the two. In this way, by placing stops on the rheostat corresponding to 3.1, 3.5, etc., the comparison voltage is made uniformly 100 volts, or some other convenient voltage if desired. For instance, with a run of 110 volt lamps, the voltage of each side of the photometer can be 110, and may be checked without moving from the same potentiometer post.

The tungsten comparison lamp has proved eminently convenient and practical, and after two months' daily running of from four to seven hours, chiefly at 3.5 and 3.1 colors, the voltage to give 16 candle power has changed less than two-tenths of one per cent.

* Transactions Illuminating Engineering Society, October, 1908.

"Electricity *vs.* Gas, Looked at from the Viewpoint of Electricity"

Oh, wad some power the giftie gie us,
To see oursel's as ithers see us!
It wad frae monie a blunder free us,
An' foolish notion.

The above is the title of an editorial in the March issue of *Light*. The familiar quotation from Burns is our own, and respectfully submitted for the careful contemplation of the genial editor of our esteemed contemporary.

But lest we be accused of failing to "practice what we preach," and having the quotation referred back to us for our own edification, we beg to quote from a leading editorial in a recent issue of the *Journal of Gas Lighting* (London), a magazine not without reputation in its particular field:

"Notwithstanding the fact that some issues of the American ILLUMINATING ENGINEER seem to be entirely devoted to electric interests, either in the way of descriptions of installations or of work in which electric lighting units play an important part, there appears to be the wish to hold the balance even between the two competitors." . . .

"Certainly, the ILLUMINATING ENGINEER is doing a fair share in stimulating the gas-lighting industry in America."

We quote the first and last sentences of the editorial, the balance of which is made up by citing editorial and other matter which goes to prove the correctness of the opinion expressed.

To return to our mutton—or lamb; our contemporary says:

"It is but reasonable to expect criticism of a general gas illumination scheme from sources electrical, and since self-preservation is a natural law, so for a journal that is perforce of circumstances especially devoted to the electrical industry one would most naturally expect happier vision under the rays of electric illumination than under the rays of illumination by gas."

Admitting, for the sake of argument, that we have shown a preference for the electric light (a supposition contrary to fact), there is all the more reason why those interested in gas lighting should give heed to our criticisms. The mutual admiration society, in which the sole duty of the members is to pat one another graciously on the back, is pleasant enough, within certain limits; but it is no place to learn one's shortcomings, or to get in line for improvement, or to discover one's true position in the race for success. "With malice toward none and charity for all" we submit that the gas interests have been too much addicted to this pastime, so far as illumination is concerned. The truth is not always pleasant to hear, and for this reason is oftenest received at the hands of our enemies, or competitors.

Our own preferences in the matter, however, really have nothing at all to do with the case in hand. It is a question of fact, and not of sentiment. The whole question at issue is this: admitting the general success of the exposition, was or was not the illumination, both exterior and interior, as impressive as it might have been made? We maintained, and do still maintain, that it was not. Our contemporary does not attempt to establish the contrary. He states that "the gas interests partake of dignity," and that

"this was a show for the displaying of the wherewithal to produce light and heat through the burning of gas, and it was not proposed to there display the methods of illumination, but the means; as, for instance, it was in the range field not sought to bake bread, but to display the means, or in other words, the gas range."

This is truly an ingenious argument. The idea of showing the "means of producing light and heat through the burning of gas," rather than the results, will strike the average mortal as having a strong resemblance to teaching swimming without water—which, by the way, suggests that our contemporary might extend his reputation for ingenuity by establishing a correspondence school of swimming.

It seems, moreover, that our criticism in regard to the illumination could have been applied with even greater force in the field of heating, since our contemporary assures us that no attempt was made to show that the gas range would bake bread, but only that it was a means of accomplishing this desired purpose. If this was the view actually held by those responsible for the exposition, it is rather surprising that the gas lamps were lighted up at all. The gas range maker, who simply showed his wares like so many lay figures, instead of performing their purpose of actual baking and cooking, most assuredly missed the most vital point of his opportunity. If there is anything in the world that interests every man, woman and child, it is to see some operation actually being performed, no matter how simple it may be. A lamp unlighted, or a stove without a fire, may as well be so many pieces of scrap iron, so far as the ordinary observer is concerned. A basin of water boiling over a common Bunsen burner would create more living interest than the most magnificently benickeled and polished gas range unused.

However, we are by no means prepared to accept our contemporary's statement as voicing the opinion of those responsible for the exposition. We much prefer to believe that it was oversight rather than stupidity, and have no doubt that the next exposition, which is to be held in Madison Square Garden, in this city, will show a full realization of the possibilities of gas as a luminant.

High Pressure Gas Lamps for Street Illumination

Reports have been coming into this country for several years, both through the technical press and from observing tourists, of the successful introduction throughout Europe of high pressure gas lamps for street illumination. In Berlin it is said that lamps of this kind make even the flaming arcs look like candles. London has extensive installations, and the same may be said of other important foreign cities. Such lamps not only give enormously high efficiencies, but equally enormous quantities of light.

The illustration on the front cover of this issue gives some idea of the results obtained from this new wonder in the lighting field.

Notwithstanding all this success abroad there is not, we believe, a single installation, even for experimental purposes, of this type of lamp in America at the present time. We understand, however, that a trial installation will soon be put up in Philadelphia. The "slowness" of the Quaker city has long served as a stock joke, but the way she has been taking hold of the better street lighting in the past few months has certainly taken the pith out of the joke, so far as illuminating engineers are concerned. The fact that the first demonstration of high pressure gas lighting is to be made there is certainly a convincing testimony as to the progressive spirit of those interested in its lighting.

It is well to recall in this respect that Philadelphia is the home of the Welsbach Company and the United Gas Improvement Company; and if this combination can be beaten for progress in the field of gas lighting we should like to discover the victor. Any commercial organization or individual that works consistently for progress is entitled not only to whatever satisfaction may be derived from public recognition and appreciation of the fact, but also to every cent of commercial advantage that may come from such publicity. The two corporations just mentioned are unquestionably in this class. The proposed test of street lighting by high pressure gas will be watched with much interest by the entire lighting in-

dustry, as well as by those interested in the problem of better street illumination for American cities.

Illuminating Engineering Terminology

The progress of a science may always be measured by the extent and accuracy of its terminology. Before the days of illuminating engineering the only term that ever reached the eyes of the public in regard to the science of light was "candle power"; and the term had almost as many meanings relative to the subject of light as the word "thing" has in common parlance. The word "foot-candle" has now come to be fairly well understood, and the word "lumen" is making good progress; its adoption as a means of rating light-sources will soon make it a common term. In the more technical circles, the word "illuminometer" may be considered established. The word "luminant," meaning the immediate agent for the production of light, such as gas and electric current, is at present struggling to establish itself in preference to the longer word "illuminant," with very good prospects of success. Of two words otherwise equally good, the shorter will naturally be chosen. The word "light" was formerly used indiscriminately to signify the sensation produced upon the eye, the physical cause of this sensation, and a luminous body. To avoid this confusion the term light-source has gained very general acceptance. While this term leaves no room for doubt as to its meaning, it has the disadvantage of being a compound word. The single word "radiant" has been suggested as a substitute, and is beyond criticism for the purpose. The word "radiator" is universally used for an apparatus for sending out heat, and the word "radiant" is of equally good etymology and derivation, and can be applied with equal scientific accuracy to a body which radiates light. This word could be used advantageously to take the place of "light-source" and "light," which are now used for the purpose of designating a luminous surface. The word should be restricted, however, to the actual luminous body or surface. Thus, the radiant of an incandescent electric lamp is the filament; of an ordinary gas burner, the flame; and of a mantle burner, the mantle. Let us add the word radiant to the terminology of illuminating engineering.

Total Lumens as a Basis for the Commercial Rating of Light-Sources

There are indications that the long continued discussion as to the proper method of rating commercial light-sources is at last drawing to a close. The fallacies and idiosyncrasies of the old candle power method were pointed out in the early days of illuminating engineering, and the crawfish progress exhibited in the substitution of the watt consumption as a rating for electric lamps has been frequently referred to in these pages. There are two fatal errors in the candle power method of rating: it does *not* give the information that is wanted, namely, the *quantity* of light emitted; it *does* give, by inference, a misleading idea to the non-technical user. Two light-sources rated respectively at 8 and 16 candle power would very naturally be supposed to bear the relation of one to two in their light-giving values; but, as every illuminating engineer knows, such is by no means necessarily true. In order to find out what their real relation is, a considerable amount of additional data must be ascertained, and computations of a more or less elaborate character made.

The rating of a lamp by the amount of luminant consumed is too absurd to be given a second thought. When the user buys a lamp the one important thing which he wants to know is: How much light does it give out? Of scarcely secondary importance is the other question, how much luminant does it use? The old candle power method of rating may be likened to the rating of a heating furnace by the temperature of its hottest spot. Intensity of light, which is scientifically described as flux density, is the exact counterpart of temperature in heat. Every one knows that it is possible to have a very high temperature with a very small total quantity of heat. To designate a lamp as a 100 candle power is an-

alogous to designating a furnace as a 1000 degree furnace.

There is a photometric term, consisting of a single word, easy to pronounce, spell and remember, which has been sufficiently used to acquire stability, and which stands for a definite quantity of light. This word is lumen. It means the quantity of light which, if spread over a surface of one square foot, will give it one foot-candle intensity of illumination, i. e., the same illumination that the surface would have if placed one foot from the standard candle-flame. The conditions for producing a foot-candle of illumination are exceedingly easy to produce and remember. If a candle is not at hand this degree of illumination may be obtained by placing the ordinary 16 candle power electric lamp four feet from the surface and sidewise to it, i. e., so that the light from the side of the bulb will strike the surface perpendicularly.

To say that a lamp gives out a certain number of lumens tells exactly what the lamp will do. The average 16 candle power electric lamp would be rated as a 160 lumen lamp. From this it is at once evident that if all the light of such a lamp be directed upon a surface of 160 square feet it would illuminate it with an intensity of one foot candle. While the word lumen is new and generally meaningless at the present time to lamp users, its full significance and appropriateness will be easily understood by any one who takes the trouble to look up its meaning. It has the further advantage moreover, of being applicable to all possible sources of light.

The general adoption of this method of rating for electric lamps would be an exceedingly simple matter in the present well organized condition of the electric lamp industries. There should be little difficulty in securing similar action on the part of gas lamp manufacturers. If lamps of every kind were thus rated the public would very soon, in mere self-defence, become familiar with the term and its meaning. This in itself would be no small advantage to the cause of illuminating engineering.

"Efficiency" and "Duty"

The first proposition in the science of illuminating engineering is that light and illumination are two quite different things. Illumination, in the engineering sense, may be fairly defined as the light utilized in rendering visible those objects which we wish to see. Keeping in view this special meaning, it follows that the illuminating efficiency of a light-source must always be different from its light-producing efficiency. It would be well, therefore, if different terms could be used to signify these two different ratios. Illuminating efficiency belongs to lighting units, i. e., the light-sources with their accessories, as well as to bare lamps. Illuminating efficiency will vary with the accessory, whereas the efficiency of a light-source as a mere light producer is independent of all accessories and external conditions.

We have already suggested that the light producing efficiency of a source should be expressed by the word "duty," which is in accordance with the terminology used in other branches of engineering. Thus, instead of speaking of an efficiency of two watts per candle, or three lumens per watt, we would say a duty of two watts per candle, or three lumens per watt. In this connection also it would be well to use the latter order, which is common in Europe, i. e., of giving the quantity of light first; thus: three lumens per watt, or 200 lumens per cubic foot of gas.

The rating of a light-source by lumens, and giving its duty in lumens per watt, or 1000 feet of gas, and reserving efficiency to apply only to illumination, would successfully obviate all possibilities of using a concentrating reflector with a light-source, and then juggling with the candle power intensity of the beam to give misleading values to the unit. While such practice is by no means common, it is entirely possible; and it is desirable to clear the atmosphere, which has hitherto, by general admission of those on the inside, been entirely too much befogged.

The Thirty-second Convention of the National Electric Light Association

The next convention of the National Electric Light Association will be held in Young's Pier, Atlantic City, June 1, 2, 3 and 4.

Just keep the date and place in mind.

Notes and Comments

Massachusetts Gas and Electric Light Commissioners in a Sulphurous Discussion

Gas Companies Want Privilege of Raising the Limit of Sulphur in Illuminating Gas from 20 to 30 Grains.

To what extent are sulphur compounds injurious in illuminating gas? This important question has been the subject of an exhaustive research at the hands of the Massachusetts Association of Gas Companies, apropos of a bill which has been pending in the State Legislature to remove the present restriction on the amount of sulphur which illuminating gas may contain. The companies contend that a removal of the restriction, or raising the amount allowed, would enable them to use cheaper coal, and hence be able to supply cheaper gas, and would also avoid unintentional transgressions of the present law. The Commonwealth, on the other hand, is using great precaution lest the way be open for supplying gas that might prove injurious to the people. While it is the duty of Public Service Commissions and Legislatures to jealously protect the health and welfare of the people, equally great care should be taken that legislation for this purpose does not stand in the way of commercial and physical progress. If it can be proven that a higher percentage of sulphur in illuminating gas is not detrimental, and that a cheaper gas can be supplied by increasing the quantity within the proper limits, then it is most assuredly the duty of the legislators to see that the gas companies are not hampered. The question is an important one, and no reasonable efforts or expense should be spared by the state in its efforts to arrive at the real truth of the matter.

Regulation of Overhead Signs

Syracuse Chamber of Commerce Investigates the Subject and Compares Notes with Scranton.

The electric sign, like any other good thing, can be abused. How to promote its use without allowing it to degenerate into a menace to public safety, or an offence to the sense of the artistic, is a question that is agitating not a few cities and towns, among them Syracuse, N. Y. A committee of the Chamber of Commerce has been considering the subject, and knowing the remarkable transformations that have been wrought during the past year on Scranton's principal business streets by the use of signs and spectacular lighting, has been studying this as a practical example.

The conclusions and recommendations of this committee are thus reported in the *Post-Standard*:

It was the general opinion of the delegates, and also of the committee, that the most effective signs and at the same time the most pleasing in appearance were those which are erected flat against the building instead of the projecting variety. Many of the store fronts and entire buildings are outlined with rows of incandescent bulbs, and this method is highly recommended. No particular objection is taken to projecting signs, provided they are constructed along artistic lines and do not make the general aspect too ragged. A large number of letters were received from other cities, giving the manner in which signs are controlled, and from these, together with the visits made to several places, the following recommendations were made by the committee:

1. Syracuse needs an ordinance governing signs. The present ordinance is wholly inadequate. No pretense is made at enforcing it. No good purpose would be served by enforcing it.

2. Signs should be erected only upon permits granted by the Superintendent of Buildings.

3. There should be regulations governing the construction of signs, guaranteeing their safe erection.

4. The wiring of signs should be subject to the approval of the city electrician.

5. There should be provision for indemnity to the city in case of accident from signs.

Cities Have no Monopoly on Good Public Lighting

Smaller Towns Fall in Line in the Movement for Better Illumination.

Modern science is fast annihilating the traditional notions of rural and provin-

cial seclusion. What with the telephone, the trolley car, rural mail delivery and the electric and acetylene light, the only distinction remaining to the city dweller will soon be his cell-like abode, and the distinction of the country man his robust health and less "advanced" morality. The electric light is rapidly reaching out from the urban centers into the surrounding territory. For example, the little village of Port Byron, some two miles out of Auburn, N. Y., is soon to be lighted up from electricity generated at Niagara Falls. It is proposed to erect a transforming station, and install 500 50 candle power tungsten lamps.

Seneca Falls is a considerably larger town, well known for its manufacturing industries. The village authorities are now negotiating with the Geneva-Seneca Electric Company for a more modern system of lighting, in which the tungsten lamp will play an important part.

Experiments in Street Lighting Continue to Hold Public Attention in Washington

Contrary Views are Held in Regard to the System of Placing Lamp-Posts in the Center of Streets.

The difficulties of properly lighting wide avenues bordered by trees have been frequently discussed, but heretofore little has been done by way of practical experiments. As noted in our last issue, the subject is being carefully investigated and practical experiments carried out by Mr. Walter C. Allen, Electrical Engineer of the District of Columbia. Residents and property owners, however, do not agree with Mr. Allen as to the advantages of the proposed system, according to the *Post*:

Inquiry among the owners of property in that portion of Massachusetts avenue develops the fact that they are almost unanimously adverse to the proposition to place permanent electric lights in the middle of the street in place of the temporary apparatus which was erected several weeks ago for experimental purposes.

The chief objection to the center-of-the-street method of lighting is that the poles obstruct traffic. A large number of the property owners say that the electric light standards would be unsightly, no matter how well they might be designed. The general opinion is that the present system of lighting is satisfactory and that no changes are necessary.

Electrical Engineer Allen reported to Commissioner Macfarland that the experiments with the temporary arc light installation in the center of Massachusetts avenue have been satisfactory, and that the temporary apparatus soon will be taken down. Mr. Allen believes that there are many points in favor of center-of-the-street illumination, and as soon as he has completed other lighting experiments will recommend to the commissioners that that method of street lighting be adopted along many of the city's thoroughfares.

Better Street Lighting Fever Breaks Out in Texas

El Paso Citizens Think Goose Necks Preferable to Plain Lamp-Posts.

Says the *Herald*:

El Paso should not halt in extending the attractive street lighting system already started on principal streets. The contrast between streets provided with the gooseneck lamps, and adjacent streets not so provided, is striking enough to impress every visitor and ought to appeal to property owners and merchants.

Buffalo Shows Signs of Waking Up

Comptroller Zimmerman Makes a Move Toward Investigating the Subject of Electric Light, While Business Organizations Claim City Has Cheap Electricity.

Buffalo has been enjoying a reform city government for a number of years, during which time considerable has been heard in regard to its public lighting. Meanwhile, it has continued to grope along in the same old ruts. There are signs of waking, however, as shown by the following items in the *News*:

Two items in the estimates which were put in by Comptroller George C. Zimmermann at his own volition have survived thus far the pruning of the Aldermen. One is $10,000 for the purpose of investigating the subject of electric lighting and its cost in this city as compared with other places, looking toward the proposition of a municipal lighting plant. The other is an item of $20,000 for the purpose of establishing a municipal lighting plant by taking possession

of the electric conduits established by electric concerns one-half of which conduits were assigned to the city in consideration of the franchise to lay the conduit systems.

The business organizations that are behind the movement to advertise Buffalo's advantages to the rest of the country have been supplied with a wealth of material during the past week, in the form of the lighting rate comparisons which have been made public by the Buffalo General Electric Company. These comparisons seem to refute the contention which has been made from time to time that the local rates are higher than those prevailing in other cities of the same class.

The company has reproduced the rate schedules of fifteen of the largest cities in the United States, and by a series of comparisons, has demonstrated that the rates charged elsewhere for residence and commercial lighting are from 11 to 135 per cent. higher than those prevailing here.

Philadelphia Continues to Agitate the Subject of Better Street Lighting

Experiments and New Plans Continue to Flourish.

From all indications the movement for spectacular lighting in Philadelphia will continue until the whole city and suburbs are one blaze of glory. The matter has assumed such large proportions that it will require more than a passing note to do it justice. A more complete analysis will be made in a later issue.

Everybody in Seattle Wants Cluster Lamps, But City Plant Has Limits

City Council Proposes to Employ Lighting Expert.

The city fathers of Seattle have gotten themselves into trouble. Decorative cluster lamp posts have been installed in certain sections of the city, and now, as might be expected, every citizen is crying for the same sort of installation on his own street. Like generous parents, they would like to satisfy all the boys, but there is a limit to their means. The *Post-Intelligencer* thus describes the situation:

A petition for the installation of a system of cluster lights on Broadway and North Broadway brought forth the announcement from the committee that a stop should be put to the cluster light craze. Chairman W. M. Hines said that Seattle was going cluster-light mad and the city should take steps to conserve its electrical power for legitimate uses on streets.

"Every suburb in town seems to be after cluster lights," said Mr. Hines. "We get and grant petitions innumerable for the installation of arc lights or common street incandescents which are really needed, and we can't install them for some reason or other. There is no use of putting cluster lights on any but the central business streets, and a halt must be called at once."

City Electrician Howard Joslyn stated that a block of cluster lights burns between five and six times as much current as an arc. In addition to this, the city's share of the cost of installation was pointed out as an argument against wholesale extension of the system.

Missourians Want to be Shown in Regard to Street Lighting

Citizens' Committee from St. Louis Visits Toledo, Ohio, to Investigate Methods Used There.

St. Louis has a Downtown Lighting Association, organized for the purpose of securing the best possible illumination for the downtown business district of the city. A committee of this Association, in conjunction with representatives of the Board of Public Improvements, recently took a trip to Toledo, in order to investigate the lighting system there, particularly the use of the magnetite arc lamp. According to reports it was found that these lamps had been entirely successful, and somewhat cheaper than the old style arc lamps at present in use in St. Louis. The system is maintained jointly by the city and the residents of the sections where it is installed.

Springfield, Mo., to Light Up and Keep Lighted Up

Commercial Club Makes Contract with the Traction Company for a System of Spectacular Lighting.

According to the *Republican*, the installation will consist of a number of bracket lights, and seven festoons of incandescent lamps, one to each of the seven blocks of the section selected, hung across the street. The city lamps will be continued as part of the system.

Correspondence

From Our London Correspondent

The price of gas in Great Britain is almost universally lower than in America. The cheapest gas supplied by any municipal gas undertaking is at Widnes, in Lancashire, averaging 30 cents per 1000 cu. ft. At Sheffield, gas is sold by a company at prices ranging from 24 to 37 cents; quite recently the engineer and manager, Mr. J. W. Morrison, stated that the increase in output in the past four years had been 22.50 per cent., due, of course, to the extraordinarily low price. The population of the district supplied is about 460,000, and no less than 93,676 meters are in use; of this number 30,069 are two-light and 42,000 three-light, so that the price shows conclusively that gas is much valued by small consumers. The question is often asked, "How is it that Sheffield can sell gas at so low a price?" Well, several reasons can be given: The capital account is very low, the company having no "dead" or unproductive capital. The buying and selling of all materials are controlled by the chairman and the managing director, both long-headed men of business. The works are situated within a short distance of the coal fields. Coal is purchased as near as possible, freight and transport are therefore low. The staple trade of Sheffield is hardware, and coke finds a ready sale "at home." The company were pioneers in the maintenance of incandescent burners. They maintain burners at a charge of 6 cents a month; for this they provide new mantles, chimneys and rods, clean all inside fittings and the outside of lamp globes, and attend to the burners every fortnight. The staff who operate this work consists of one foreman and 33 men; they have just about 30,000 burners under their charge. In order to increase consumption two canvassers, or as you would call them, solicitors, are told off to secure orders for incandescent burners and lamps, giving estimates for the better lighting of shops, etc.; no free fittings are supplied, and cost price is generally charged, the executive being of opinion that if a thing is worth having it is worth paying for. Lectures and demonstrations are given during the autumn and winter evenings, which are largely attended and much appreciated by consumers; an immense amount of trouble is taken to explain to both workmen and consumers the practical construction and use of the Bunsen burner, incandescent, vertical and inverted burners, gas fires, stoves, methods to be adopted to insure efficient ventilation, and the construction and use of all modern gas-consuming apparatus. These, then, are the means that have enabled the Sheffield Gas Company to sell the cheapest gas in Great Britain.

Railway companies are rapidly going back to the lighting of their carriages with gas; to this end both upright and inverted burners are being installed. The writer travels daily on one of the Southwestern suburban lines, the carriages of which are brilliantly illuminated by means of a specially inverted incandescent burner. The mantle would measure about $\frac{5}{8}$ in. in diameter, and $\frac{3}{4}$ in. in depth; a pilot burner is left alight, the flame being almost invisible.

Quite recently some experiments were conducted on the Isle of Wight Central Railway, one of the smallest concerns in the kingdom, with coal gas for lighting their carriages. The gas was supplied by the local gas company at a charge of 92 cents per 1000 cu. ft.; the gas was compressed into a series of five cylinders, each measuring 9 ft. long by 20 in. in diameter, to a pressure of 150 lb. on the square inch. Ordinary regulators and fittings are used

ST. SEPULCHRE CHURCH, HOLBORN, LONDON, LIGHTED WITH INCANDESCENT GAS BURNERS.

throughout, and small upright incandescent burners and mantles. The pressure at which the gas is supplied is from 1½ to 2 in. The illuminating value of each burner is stated to be equal to 25 candles. Tests were made with four carriages running continuously for sixteen days with the following results:

Burners in use	19
Mantles renewed	4
Mantles, cost each	.12
Total mileage	2,350
Average hours burning	4.5
Gas consumed	3,200 cu. ft.
Cost of gas	$2.94
Consumption per burner per hour	1.63 cu. ft.

The experiment would appear to be highly satisfactory. Possibly the mantle consumption might be lessened, but the roadbed of this small railway leaves much to be desired, and consequently breakages of mantles is due to abnormal vibration.

Through the courtesy of Messrs. Geo. Bray & Co., we are able to give a reproduction of a famous London church, St. Sepulchre, Holborn, lighted with incandescent gas burners. The architect of this church was Sir Christopher Wrenn; it has for many generations been one of the landmarks of the city; when Newgate was the City Jail, prisoners condemned to death were hung on a scaffold erected outside Newgate, and the bells of St. Sepulchre were tolled. This practice was continued after hanging in public was abolished, the demise of the poor criminal being made known also by the hoisting of a black flag above the gates of the prison,—but now *vous avons changez tout cela;* the old prison has been razed to the ground and in its place the city of London has erected a handsome building in which all criminal cases are tried, and although there are many cells built upon the most approved system, prisoners are no longer detained except during the trial, and then, except in most exceptional cases, they are removed each night to one of His Majesty's jails outside the precincts of the city of London. Perhaps we shall be pardoned this slight "divarsation," as the Irishman would say.

By-the bye, these City Criminal Courts are lighted by electricity with Moore

tubes laid upon the upper sides of the cornices in the courts, halls, etc.; the source of light is quite invisible, the light being thrown up on the roof. Doubts are expressed as to the ultimate success of the system, in the courts particularly, which are crowded, the heat evolved from the motley gathering naturally ascends, and as a consequence dust and moisture are freely deposited upon the exposed surface of the tubes. We hear also that keeping them clean will be a difficult matter. In order to provide against any failure of the electric light an elaborate system of gas lighting is installed; brackets with a pilot and full supply of gas are fitted throughout the huge pile of buildings; the pilot lights are always burning, and sections of burners are controlled by special taps on the full supply service, so that at a moment's notice the burners can be lighted up. We believe that the architect in planning this installation has not attempted to make the lighting competitive with the electric light, but sufficient to prevent a panic should failure of the sister luminant take place.

Those interested in the education of gas engineers, and the advancement of the science of gas manufacture and its uses as an illuminant will, we are sure, be glad to know that since our last letter the money received or promised for the Chair of Gas Engineering at the Leeds University has been $43,000, leaving $4800 to be collected; there is no doubt that the full sum will be forthcoming. It will, we suppose, be possible for a student to take his B. Sc. in gas engineering, etc. In this educational movement we think that the Britisher, slow-going though he may be, will score one against his cousins across the "silver streak."

C. W. Hastings.

London, April, 1909.

From Our Berlin Correspondent

Unusual interest in the incandescent mantle industry has been caused by the remarkable rise on the Berlin Bourse of the shares of the Auer Company. At the time I am writing this they have reached over 500. At one time, however, their value was 1000. A large number among the gas interests at that time were in transports of joy, and many new competing companies were established, most of which have since become bankrupt. The good showing of the Auer Company at the present time is hardly likely to induce capital to be invested in similar ventures. I believe the present excellent condition of our largest company is due to nothing but sound, natural development. It must not be forgotten that this company is no longer confined to the incandescent mantle industry, but have extended their business by the addition of an electric department. This latter has passed the experimental stage, and is working side by side with the gas department with equal success. During the past year the profit in the electrical branch was double that of the preceding year, making possible a dividend of 35 per cent.

A consideration of the other German firms in this line presents quite a different aspect. During the past year Germany has suffered a general economic depression, affecting all industries, not excepting the lighting industries; the exceptional success of the single firm, which was fortunate enough to come into the market with a new article, for which there was a great demand, does not disapprove the general fact. The year 1908 was by no means a good one in the incandescent mantle industry, but from reports which have reached the writer from all sections, the conditions for the first quarter of this year are much better, and there is greater hope for better times now than there was a year ago. The stagnation still existing in the lighting industries may be explained by the uncertain feeling aroused in regard to the proposed action of the government to tax light. This proposition was discussed in my last letter. So long as such a Damocles' sword hangs over the industry, no great development is possible.

It may not be generally known that the majority of German lamp manufacturers and dealers about 15 months ago established an association to promote their mutual interests. Even this short period shows that their efforts have been successful. After long and somewhat spirited contests with certain syndicates the association succeeded in fixing standard prices, varying with the quantities sold. This arrangement has proved beneficial

not only to their own interests, but to the glass industry concerned with lighting glassware, the small factories, and particularly the retailers. The association has great power, but has thus far not in any way abused it in order to secure unusually favorable conditions. It is the duty of the members not to buy from outsiders. The association covers the whole of the German Empire, and includes at present 66 of the largest lamp manufacturers.

There is one general meeting each year, besides smaller meetings. Combination in business is a source of power and economy. Each industry and commercial development demands more or less concentration in all fields of human activity. Where formerly there was ruinous competition, there is now mutually advantageous co-operation.

Considering the advantages of co-operation in this as well as other industries, a number of firms handling electrical specialties propose to establish an exhibition of their products at the world famous Leipzig fair the coming autumn. They purpose to show the novelties and improvements in the electrical field by actual demonstration to the international gathering of buyers and interested parties who gather twice a year, at Easter and in the fall, at this famous exposition. The exhibitors will profit by the enormous number of buyers who come from far beyond the German borders. Last year each fair was attended by 1300 local firms and 210 foreign. This number should be increased by the addition of the electrical exhibitors. By such a collective exhibit the manufacturers will effect a saving for rent, attendance, advertisements, etc., over the method of showing in separate buildings in the city, as heretofore. Such an exhibition will, therefore, prove profitable to all participating, as well as an additional attraction to sight-seers.

MAX A. R. BRÜNNER.

Berlin, April, 1909.

From Our Baltimore Correspondent

The public, self-thinking and uncontrolled, is at all times ready to grasp at a change of venue from what has been, to that which still remains in doubt, and demands a variance of both necessities and luxuries. That "variety is the spice of life" is surely true; man cannot exist working and living along the same daily lines, which at length must grow monotonous and tiresome. As the styles change from fall to spring, bringing new suggestions, so do also the merchants themselves see the necessity of a change in appointments in their shops, be it either exterior or interior; and it is these transformations and rehabilitations that at once magnetize the prospective purchaser.

The vast commercial advantages that are to be gained by advertising through the liberal use of modern luminants are too well known to need further comment; however, the many methods in use by which success can be thus attained are both instructive and interesting. With the practical plans in the possession of our lighting engineers there is no justifiable excuse for inadequate illumination.

The community at large require at all times ample light. In the stores they need it to properly make their purchases; in the restaurant, by stimulating cheerfulness, it aids digestion; in the office they require it to perform their daily tasks; in the home it is particularly desired to ease the mind after a hard day's work; in the club it promotes good fellowship. It is this valuable adjunct that has made so many stores in Baltimore successful, and there exists a keen rivalry between the storekeepers to see which will surpass in brilliant illumination; no money is spared to make the lighting of the windows and stores stand out in impressive elegance. Various methods are adopted, some along scientific lines, others the result of mere business judgment, and others with strict regard to economy and efficiency. All agree, however, that salesmanship, decorations, etc., are insignificant as compared with adequate lighting, and with this fact in mind have expended thousands of dollars to create that confidence in the minds of the public which is inspired by the frankness which light proclaims.

An attractive scheme of exterior lighting has been installed on the large five story building occupied by "The Hub," a department store situated at the intersection of two of the most prominent thoroughfares; the entire building is out-

lined with small incandescent lamps, the long arches of the windows adding grace and harmony to the straight lines of lights arranged along the cornice, and all presenting a most pleasing and unique appearance. The interior as well has been liberally lighted by arc lamps with metal diffusers; the windows are equipped with concealed reflectors, which with the aid of a bright background are most satisfactory. The success of this store is shown by the fact that contracts have been awarded and work begun on a large addition to take care of the increased business. More light has always been their aim, and success has necessarily followed.

Other merchants are equally enthusiastic in their praises for Nernst lamps, the most prominent of which is the new store of the Walk-Over Shoe Company, recently opened, where both the store and windows are lighted by these lamps. The result has elicited much favorable comment.

It would be impossible to estimate the number of stores that are now lighted with tungsten lamps, so many having adopted this new luminant. Gas lighting has also come into prominence in a number of cases of long-hour users of light, who have substituted the modern gas arc for the electric light from economical motives.

An interesting test will soon be made by the Lighting Department of the new inverted gas lamp for street lighting. Arrangements have been made by which a number of these new units will be placed in temporary service so that their efficiency may be thoroughly tested, with the intention of ultimately adopting and purchasing the equipment provided the experiment is found satisfactory after investigation by the department. The lamps, which are of a German type, have been tested in Boston and found satisfactory.

It might seem strange to know that a city of this size should still have naphtha lamps in use, but the Superintendent of Lamps and Lighting has instructed the lighting company to make an inspection of the district where naphtha lamps are in use and report to him the cost of having all such lamps replaced by incandescent gas lamps. This will mean a saving to the municipality of approximately $10,000 annually. There are at the present time about 1000 naphtha lamps in service, each costing the city about $25. If gas lamps are installed there will be a saving of $8 per lamp. The rapid extension of the mains of the gas company makes possible the installation of gas lamps where formerly only naphtha could be used.

The recent storm of March 3 and 4 demoralized the entire overhead lighting service of the city, and as a result the streets and houses were in darkness for several days, so far as electricity was concerned. This recalled conditions that existed fifty or a hundred years ago; oil lamps were brought into service, and in some cases candles were the only luminants. The darkness of the streets, combined with the conglomeration of falling wires, made travel at night extremely dangerous. Many stores without gas found it impossible to do business; places of amusement barred their doors, and the public resigned itself to a siege of indefinite length. When the current was again placed in service the glories of illumination were more forcefully appreciated.

SYDNEY C. BLUMENTHAL.

APRIL, 1909.

From Our Readers

March 16, 1909.

To the Editor of THE ILLUMINATING ENGINEER, *New York:*

My Dear Sir:—In reference to the new high efficiency incandescent lamps, last year's progress was marked and gratifying.

They are found everywhere and are most prominent in show window and interior illumination.

Of an installation of between sixty and sixty-five million incandescent lamps, six million were of the tungsten type, of which probably five million were made in this country. In addition to this number, about one million American made tungsten lamps were used.

Increased volume of light, rather than reduced consumption of current, seems the present tendency. This frequently passes beyond the limits of attractiveness, and may even reach a degree trying upon the eyes. These newer efficiencies make light so cheap that excessive—as well as deficient—illumination may be a future problem in illuminating engineering.

General agreement concerning the immediate effect of these lamps does not exist. This is not equally true of their prospective effect. It must be admitted anything which cheapens good illumination will greatly extend its field of usefulness and add to the prosperity of the industry.

The smaller units, now made to burn in any position, are most acceptable; they meet the larger wants of the consumers. Physically the size of the standard lamp of 16 candles consuming 50 watts, they give 25 per cent. more light and consume half the current.

Were this ratio to hold throughout the available sizes of tungsten lamps, the practical effect would be more light and a reduction in the cost of current which no company could afford to make and remain solvent. Thus, in effect, the 15 cent rate becomes 7½ cents; the 12 cent rate 6 cents, and the 10 cent rate 5 cents a kilowatt hour.

The public has received these new lamps as would be expected of a new and great improvement, which so materially contributes in convenience, pleasure and health. They know that some defects are inherent to a thing so new; that they have been or will be lessened, or eliminated, with surprising rapidity. That is the well known history of the electrical industry.

Each new illuminant added to those available for public use is an increasing reason for the continued existence, growth and prosperity of our newest profession—illuminating engineering. Each broadens the field of service and makes experience and advice more valuable and necessary. Truly yours,

ARTHUR WILLIAMS.

Chromatic Aberration of the Eye

We see because of the images that are formed on our retinas, but for every object at which we look there are several images formed on the retina, only three of which have any appreciable effect, and these are the images formed by yellow, red and violet, or blue-violet light. Of all these, the retina is most sensitive by far to the yellow, with the result that we fail to see either the red or the violet images under ordinary circumstances, but if we can cut out the yellow light and have only the red and the violet coming into the eye, then it is possible, where the object looked at is bright, to see two images of the same, one in red and the other in the violet. This can be done by using what is known as cobalt-blue glass, a glass which is of a violet-blue color, and which yet permits both red and violet light to pass, cutting off all others. If we look at a light placed behind glass of this kind it is possible by experimenting with various lenses to see this light with a red border quite wide, or to see it with a blue border; and by noting the width of that border, and by making calculations which take into consideration the refraction of the eye under test and the kind and power of lens used, it is possible to estimate in dioptres just what the chromatic aberration of the eye is. Usually it will figure out between ¼ and ½ dioptres.—*From The Optical Journal, New York.*

A Pin-Hole Experiment

By getting under a bright light most of us can cause the pupils of the eyes to become so small that they act as pin-holes. Suppose we put our eyes out of focus two or three dioptres by putting in front of them the proper plus lenses, or we may be presbyopes when the plus glasses will not be necessary; then by taking a newspaper out in the sunlight and facing in the direction of the sun, though not looking directly at it, we will find that we can read the paper without any great trouble. This is due to the fact that we have made pin-holes of our pupils, and hence, though we do not see through them as well as we do with the eyes in focus and the pupils of full size, still we can see the print well enough to read it.—*From The Optical Journal, New York.*

CASHIER BOOKKEEPER CONTRACTS ADVERTISING

Commercial Engineering of Illumination

The Passing of the Drummer

The writer who had a fancy for historical subjects could find a wealth of material, brilliant in local color and throbbing with human interest, in the various types of men and occupations that have come and gone during the different periods of our national development. Changes in the physical condition of the country have had their counterpart in the occupations and social types of the inhabitants. The itinerant tinker in New England, the old-time darkey of the South, the gold miner of California, the cowboy of the plains, are personifications of physical conditions that have come and gone in the evolution of our enormous natural resources and heterogeneous population.

Commercial methods of to-day are as different in magnitude and detail from those that existed a century ago as is the Western farm with its 1000 acre fields from the rocky hillside plots which the New Englander tilled in the days of our grandfathers. The "pack peddler," with his store of merchandise on his back, was a recognized mercantile institution less than a half a century ago; and the tin peddler, who went his rounds in a more elegant and dignified manner, with horse and wagon, gathering up rags and old iron in exchange for pots and pans, is not yet entirely extinct, although his race is nearly run.

An occupation was developed about two generations ago which produced as distinct and as well recognized a type of character as the abolitionist or the Southern planter. This character was given the metaphorical title of "drummer." Just how this appellation arose it is impossible to say; doubtless, however, it was the invention of some one of the class to whom it was applied. This species of the *genus homo* has been a source of innumerable jokes, and has figured in the literature and the drama of its time. Like Uncle Sam and John Bull, it became so generally recognized as to acquire a personality portrayable by a common portrait. The essentials of this delineation wore a strong, but bold and somewhat vulgar face, the inevitable sonorous plaid suit, hat tilted to one side, and an air of good natured swagger. The hand satchel, or sample case, was the badge of his profession.

The requirements of this calling were by no means small or common. The drummer was comedian, gamester, novelist, *reconteur,* salesman and all around good fellow. He had to be possessed of a ready wit at all times; to be able to argue, even on politics or religion, without giving offense; to tell a bigger lie or a viler story than the most vulgar villager; to fondle babies, and be gallant to the ladies; to show an intelligent interest in every man's particular "shop"; to be germ and bug proof, and have the digestion of an ostrich; and withal be able to send in goodly sized orders to his "house." That such requirements did not produce Chesterfieldian manners, nor develop a high grade of the "psychology of salesmanship," goes without saying. Vulgarity often passed for wit—as it does occasionally in Shakespeare's writings—and bluff and bluster for argument and fact.

But like the cowpuncher and the gold seeker, the character was not without its virtues and its romantic side, and its passing leaves a void in our picturesque American products that will never be wholly filled. Tales of the drummer will long continue to stir the imagination of the present generation, like memories of the "original minstrels" and the traveling troupes of barnstormers.

But times change, and with them manners, customs and laws. The drummer is a thing of the past, although to memory dear. Methods of selling have been changed as radically as methods of manufacture. Both have ceased to be trades and become sciences. Graces, or disgraces, of accomplishment are no longer thought to be essential qualifications for the commercial representative. Knowledge in its broad sense is now the prime requisite. So fully has this fact become established that selling is not infrequently classed among the engineering sciences. "Commercial engineering" does not inaptly signify the most advanced views of present day commercialism.

Still there are occasionally to be found those who think that selling goods is a joke; but where is the buyer who looks upon his duties as a comedy? The varied qualities of the drummer, with the exception of his insight into human nature, would be either superfluous or positively detrimental to the commercial representative of to-day. In place of these is demanded exhaustive and accurate knowledge of the particular class of merchandise in which he is interested; affability and dignity—which together make up the chief quality which we ascribe to the general term "gentleman"—and the ability to set forth facts in a logical and convincing manner, are the qualifications of the modern salesman.

It is one thing to entertain, physically or mentally, and quite another to convince. Where is the lover, in fact or fiction, that ever won his suit by mirth-provoking words or actions? Purchasing goods is an equally serious business, at least in the mind of the buyer at the time of making the purchase. The giddy clothes, the swaggering air, the rancid story, are as out of place to-day in salesmanship as the brimstone sermon in religion or the subscription premium chromo in art. Buying has become a science, as well as a selling. The buyer is after facts, not fancies. What have you to offer? What are its particular merits? What are your methods of dealing? What is the price? All other matters may be left to the social club, the vaudeville stage, or the corner saloon.

Let it not be inferred, however, that personality has ceased to be an element in commercial transactions; the reverse is true. With a higher degree of general intelligence personality has acquired an even greater value, but it differs radically in kind. The absolute sincerity and a conviction that he is presenting the exact truth as he sees it are as characteristic as natural humor or shrewdness, and this is the personality that counts to-day.

With the passing of the drummer in the flesh has also come an equal change in the impersonal field of salesmanship, known as advertising. As literature persists longer than persons, so the kind of advertising which is the literary counterpart of the drummer, is more in evidence at the present time. The points of similarity between the two are easily traceable; for the long distance plaids of the clothing there is the bold faced type and colored paper; for the ribald joke there is the Comstockian picture; for the low comedy wit there is the "smart" but pointless gibe; for the vulgar familiarity there is the loose and slangy English. The ulterior motive is the same—to trap the possible purchaser by baits appealing to his grosser instincts. It is a curious commentary on the implied estimate of the purchaser's character and commercial ability that he should be thought capable of persuasion by such essentially childish expedients. As if a grown man, with sufficient capability to be entrusted with the expenditure of money, could be wheedled into buying by being tickled with a straw!

"To look at a brass band," said Beecher in one of his sermons, "you would think that the bass drum, from its large size and the flourishes with which it is played, was making all the music. And yet what is a drum? Only a sheep-skin stretched over nothing. There are a good many bass drums in the pulpit." Drum head advertising matter is at least equally

common. The noisy vibration of empty words that have neither pitch, timbre, nor harmony may assail the eye and "split the ears of the groundlings," but will hardly induce an intelligent man to part with his money.

Of course, genuine wit and humor are never out of place in any kind of writing. Perhaps the most conspicuous example of advertising literature which possessed transcendent value on this account was "Billy Baxter's Letters," which incidentally set forth the virtues of a medicinal water. So great was the popular demand for these leaflets that they had to be shipped literally in carloads. But there is nothing quite so ludicrous as the unsuccessful attempt to reach the sublime or the tragic; and the witticism that fails to reach the mark is insipid to the point of nausea. Horse-play and buffoonery, whether in personal antics or verbal maneuvers, are an insult to the intelligence of a modern business man, and should be left to the curb-stone fakir, or the mendicant merchant of the county fair.

Advertising has this in common with all literature: its cardinal virtue consists in saying something that the reader wants to hear. It must either express the old or familiar thought in a new or impressive manner, or it must give information and facts which are valuable in themselves.

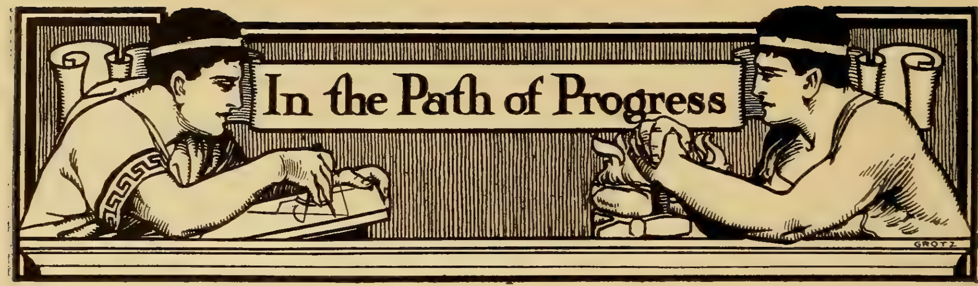
A number of years ago one of the great steel companies set about getting up some advertising literature. Following the idea that information is always acceptable, and therefore generally preserved, the company compiled a work which gave every ascertainable fact in regard to sizes, shapes, strength, weight. etc., of every regular form of steel which it produced. The task was not a small one, but the result was a book which no engineer could afford to be without, and which was therefore not only read, but sought for and kept ready to hand, and thus served the purpose of a personal representative in every engineer's office. It was of course not long before the example was followed by competing companies. This was an ideal piece of advertising literature.

There is not a single article of commerce which has not a certain amount of human interest from the very fact of its being used by man, and therefore something interesting can always be said of it. The value of making advertising matter real literature is becoming fairly well understood, and the printed matter of the drummer type is accordingly disappearing. The magazine writer or professional *litterateur* may sneeringly object to applying the term literature to advertising, but an unbiased consideration of the matter will reveal the fact that, judged on the broad basis of originality, terseness, plain language and form, a considerable amount of it has a far better claim to be called literature than most of the writing in the newspaper press, and will compare very favorably indeed with the majority of books and magazines. In America no talent is above purchase; and commercialism unquestionably has the wherewithal to purchase, whether it be raw material or literary genius.

As the "drummer" has been succeeded by the commercial representative, so the advertising "circular" is being replaced by the booklet, or brochure. When writing for information the buyer no longer commonly says "Please send circulars," but "Kindly send me your literature."

In no department of trade and commerce is it more desirable to eliminate the drummer, both in person and in print, than in the lighting industries; and to the credit of those engaged in these industries be it said, in no field has this been more fully accomplished. Light is a commodity which concerns the higher nature in every case, whether it be for the use of the common laborer or the illumination of the inner sanctuary.

In the manifold activities of civilization there are of necessity many phases of commerce and labor which are essentially gross; but not so in the field of illumination. In point of numbers, as well as in total money value, the home is the most important item in the use of artificial light. The commercial side of the lighting industry, therefore, deals with the best elements and sentiments of the social fabric. Light is a physical revealer of the truth, and it is practically impossible to use it in such a way as to lower the moral standard. The necessity of keeping the commercial propaganda on the highest plane of ethics and intellect is, therefore, self-evident.



Combination Westinghouse Nernst Lamp Chandeliers

We have already taken occasion to comment on the ingenious construction and exceptionally artistic designs of the new Westinghouse Nernst Lamp Chandeliers. The latest bulletin issued by the company illustrates three combination chandeliers which are equally ingenious and decorative. These are shown in the cut below.

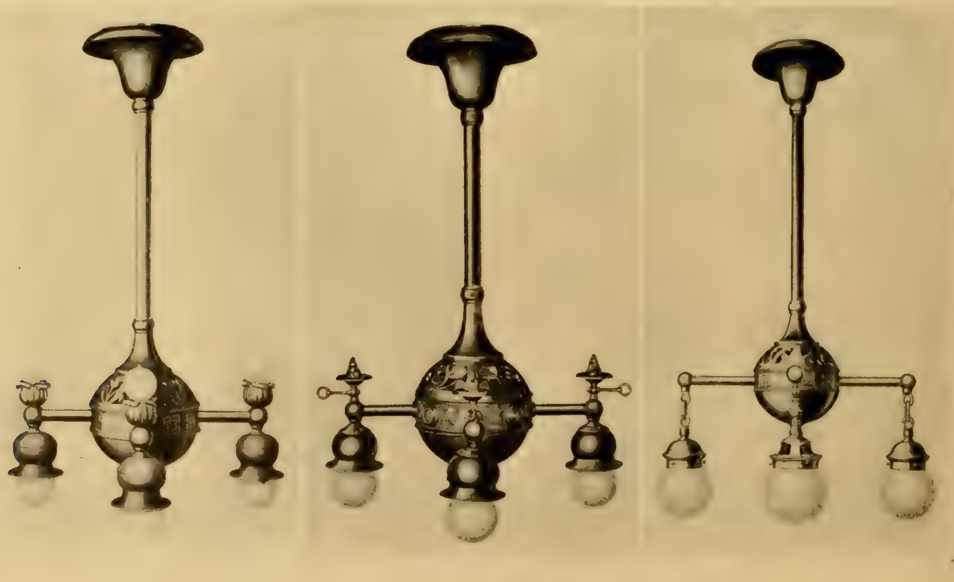
No. 1 is a combination of a small carbon filament lamp in a round frosted bulb placed in series with the heaters, or starting coils. When the current is first switched on these lamps glow, thus producing instant illumination; but as soon as the glowers of the Nernst lamp take current and become luminous the incandescents are automatically cut off. No. 2 is a combination of a gas flame burner with Nernst lamps, and No. 3 a combination of inverted mantle burners.

The same excellent taste in artistic treatment that is so marked in their other chandeliers is plainly in evidence here. The combination with the inverted mantle burner strikes us as being particularly neat and clever.

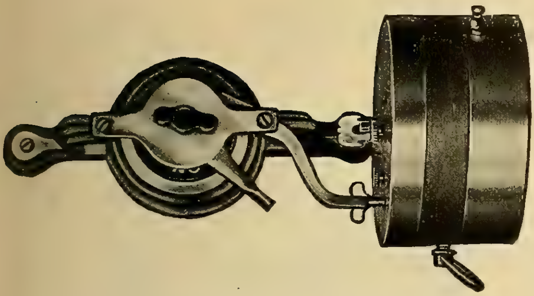
A Simple and Effective Time Switch

The Central Electric Company, of Chicago, contributes the following very timely remarks on this important subject:

The use of time switches is rapidly increasing as their various applications become generally known, and these conditions have created the demand for a simpler or less complicated device than has frequently been secured in the past. To meet the demand for a rasonable priced switch having capacity up to and including 35 amperes,



WESTINGHOUSE NERNST COMBINATION CHANDELIERS.



CENTRAL ELECTRIC COMPANY'S NEW TIME SWITCH.

the type shown herewith has been developed.

The switch mechanism is of the well-known double pole type, and so located as to be operated by means of a tripping mechanism controlled by a standard clock. To operate the device it is only necessary to close the switch and set the clock at any hour it is desired to have the switch opened. At this predetermined time the clock releases the locking toggle and the switch is instantly thrown open by a suitable controlling spring.

Time switches have been found especially useful in connection with the sale of current on a flat rate basis, that is, where lamps are to be switched on or off at definite hours on a fixed charge for current. Current for tungsten lamps is being sold on this basis in many cities.

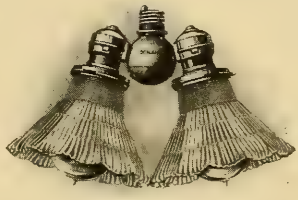
In stores and apartment houses the use of time switches not only effect a great saving in current used, but what is often more important, assures punctual service that attendants will not give. In small stores it often happens that every one is busy at the time when the lights should be turned on. In apartment houses the halls are frequently dark through forgetfulness or absence of the janitor. With a time switch the lights are always on and off at the right time.

When show windows or signs are located near theatres or other places of amusement it is very desirable to have them illuminated while the crowds are passing. The time switch can be set to turn the lights off at any desired time, and makes a trip to the store unnecessary.

The time switch can also be successfully used in public or private illuminating plants for controlling service at a flat rate during specified hours. There are many other situations where it can be used for convenience and profit as, for instance, in charging automobiles or storage batteries of any kind and in every place where the current should be turned on and off at definite hours.

Clever New Tungsten Lamp Fixtures

The name "Benjamin" on an electrical device has become synonymous with ingenuity, common sense and good construction—a combination of virtues that is hard to beat. The illustrations show the latest efforts of the Benjamin Electrical Mfg. Co. in the way of tungsten lamp fixtures, which are thus described:



A TWO-LIGHT TUNGSTEN ADAPTER.

A FOUR-LIGHT TUNGSTEN FIXTURE.

The two accompanying cuts show two of these devices. The first is called a two-light tungsten adapter. It is furnished with plug and rotating sleeeve for attaching without turning the device. It requires no wiring, and is especially serviceable in connection with the use of two lamps in series.

The second fixture is made from two to

five lights. Has arms of ½-in. brass tubing and ⅝-in. casing permanently attached to the socket and 2-in. ball which serves the purpose of centerpiece. A removable cap at the bottom of the lattter facilitates ready access to the wiring while the knock-out bushing permits the use of a pendant switch.

The new bulletin, called their Tungsten Bulletin No. 3, has been issued covering this entire line.

The "New Wrinkle" Pull Socket

The so-called "pull socket," in which the switch is operated by pulling a chain instead of turning a key, has many advantages over the ordinary key socket—so many in fact that we believe there are few cases in which it might not be substituted to advantage. The Bryant Electric Company, Bridgeport, Ct., announce a socket of this description, which embodies also the salient features of their "New Wrinkle" key sockets, which we have previously described. One of the chief features of this new socket is that it may be wired without detaching the switch chain, the two parts of the shell being separable without interfering with the switching mechanism. The "New Wrinkle" principle, which enables the chain to be put in position with reference to the fixture after the socket is installed, is also as advantageous with this type as with the regular key socket. Altogether the socket is a distinct step in advance in this line of fittings.

THE "NEW WRINKLE" PULL SOCKET

Here is a "Lite" Instead of a "Lier"

The larger total candle power of the tungsten lamp does not remove the advantages or necessities in some cases of using them in clusters. Thus, where large units are desirable, or where outlets are already arranged for arcs or other large units, the cluster tungsten lamp fixture comes in to fill the want. The Central Electric Company, of Chicago, thus describe their new fixture, to which they have given the trade name "Tungstolite":

THE "TUNGSTOLITE."

The "Tungstolite" does not differ materially from the accepted standards, is pleasing in appearance and embodies a number of structural features which are of interest. The reflector, 18 in. in diameter, consists of an opal glass shade, formed to the proper angle to give best diffusion of light and the highest reflecting qualities. The brushed brass canopy is 4 x 5 in., the stem consisting of ½-in. iron pipe covered by 1-in. brushed brass casing, thus giving a pleasing and uniform effect.

Each "Tungstolite" is supplied with an iron crowfoot, fastened to white porcelain steel reflecting plate, on which sockets are mounted, wired complete with No. 14 double braid, rubber covered wire throughout, and all connections securely sealed with a high grade insulating compound.

The fixture measures 25 in. over all when assembled with lamps, and can be used with 25, 40 or 60 watt tungsten lamps, as desired, and are made for three and four lights in circle.

Proceedings of Technical Societies

Why the Gas Man Should Be an Illuminating Engineer

By Norman Macbeth.

Abstracts from a paper presented to the New England Association of Gas Engineers.

I believe that a working knowledge of illuminating engineering is necessary for the success of your business, and the final success of your business is shown by how many thousand feet of gas you can sell which will not leave an impression in the mind of the consumer that he is paying "all the tariff will bear," but rather one of pleasant surprise when he realizes how much real service, how much useful illumination, he has had for the amount charged.

When a gas salesman advises the use of the right burner in the right place, he is practicing illuminating engineering—doing all that the engineer would do. The basis of success is founded upon a right conception of the work to be done, and the aid which illuminating engineering can lend to the success of the gas company's new business department is, I think, capable of being turned to greater value than any other line.

Salesmen should know something about the principles of illuminating engineering and be brought to know the difference between good and bad lighting. Mistakes are made in the attempt to show a working knowledge of illuminating engineering, which is conceived to consist of the manipulation of curves, flux factors, coefficients of reflection and other peculiar and mysterious terms. We should always remember that one of the first principles of this science rests on common sense.

As manufacturers of gas and accessories, we are more prone to look at our output and feel satisfied at the results, than to look over the territory and fully realize its undeveloped condition. Selling satisfactory illumination is undoubtedly above gas by the cubic foot or burners by the dozen. It is a proposition, however, which ultimately means more gas and more burners; sales which stay sold. I have found greater business success in rendering the best service possible to all customers, whether the orders were those showing $1 or $10 net profits, and have had many opportunities to note how this policy is appreciated. This policy is to recognize no connection between sales and service. Look after the service and the sales are generally forthcoming.

More talking points should be built about quality, not, of course, neglecting price, but using favorable cost comparisons more as good measure to finally clinch the argument.

Do not exaggerate the advantages of gas illumination. You don't have to, and I would much rather sell gas with a liberal discount of its fitness and illumination possibilities, than describe it fully and exactly. A customer who feels that his purchase is better than he anticipated will do more for you and go farther out of his way to get or give more business to you than one who may have been strongly canvassed and had his enthusiasm brought to a white heat point.

How many gas men to-day feel that they have the electrical interests on the defensive? They have—almost—although the day is fast approaching when the electrical interests will cease to quote cost comparisons and depend altogether on the representations of how much they can give for a dollar, how much useful illumination, how much convenience, how much satisfactory, troubleless, complaint proof service. It is "up to" the gas man to nip this canvass in the bud.

The thousands of places which can be illuminated satisfactorily with mantle burners are going to wait just a little while longer, until the tungsten lamp manufacturers catch up with the demand and perfect their product or you get out and properly equip them with the right burner in the right place, installed in such a manner that the order will be a repeater and not a clincher for the electrical interests' arguments and talking points.

You have a good thing, but merit as an

advertising agent is slow, too slow for to-day. You must tell about it. You must put up your "front"; if you have not confidence in your product you cannot expect your customer to enthuse. In the "New Business Report, 1909," of the National Commercial Gas Association, I noted that 45 pages were given over to industrial fuel gas and 8½ pages to gas lighting. This was out of 136 pages total.

You must command respect first, then show your man how you can give him more of a better product for a mere consideration to what he would have to put up with in electricity. Understand, I don't mean that electricity will not do all or as much in illumination as gas, but electricity is not furnished on any such a liberal basis. Electric service has not been gauged by what a man should have or would like to use, but rather by what he thinks he can afford to pay for in watt hours. This is no small amount. Do you realize how much gas, how many burners, how much of that main ingredient (I. & M.), inspection, maintenance and attention you could afford to give for that amount? Does he know that you could give him a standard of illumination which would be so satisfactory that electricity would have to be sold at about 4 cents instead of 10 or 20 cents, as it is still in many parts of this country? With electricity at 10 cents, which is quoted as an average price, your gas is worth $2.50 per 1000 cu. ft. on the basis of effective illumination.

If a competitor does something better than you do, get into the band wagon and do the thing as well, or better, than he does it. It is better to climb into the Car of Progress than to stand in its way. In proportion as you increase the value you give for a dollar, just so will you find it easier to get the dollar.

The electrical interests have always been on the defensive, but a short time ago, they were telling us that with electricity at 10 cents a unit they were on an equal basis to gas at $1 per 1000.

Do the general public know that the comparison was made against a 5-ft. flat flame burner, and a 16 candle-power incandescent lamp? Having this point thoroughly grounded, is it now any wonder that many believe that with tungsten lamps gas is on the toboggan slide so far as all competition in price is concerned?

The consumer who has had the questionable experience of cheap mantle burners purchased from a department store, and attached without any special attention to outlet arrangement, distribution of light, character of glass ware, pressure, adjustments, or the purpose for which the light source was required, is not the man who can give you the best reference. How often have we seen inverted burners used for lighting long, narrow corridors, where upright burners would give a better distribution; or placed on low brackets on the side of a large room, when upright mantle burners with artistic glassware, if attached to the central fixture where they would be in entire harmony with the general treatment of the room, would present to the eye a pleasing and satisfactory arrangement.

It would appear that the "duty" to-day is to be performed by the illuminating engineer. It is he who can best serve as your representative with the consumer, who can help you to lift gas to a higher plane, to a point more above the competition line.

Illuminating engineering to the gas companies means satisfactory sales and an ever-increasing business; to manufacturers of accessories, it means sales by the dozens and hundreds where formerly some sales required special attention and a high standard of salesmanship to sell a single piece. To those employed it means better positions and more chances for advancement. To the public it means a higher and better standard of illumination, 100 cents for a dollar.

The illuminating engineer should be a vast help to the well managed gas company. It is he who brings in the individual touch between the company and the consumer. It is he who gives that personality which is an important element in all business transactions, and which, I believe, means much in the matter of the securing and retaining of profitable relations. The electric business has in the greater part of the field been sold, and is a commodity requiring skillful and constant attention to insure its continued sale. I am speaking of the bulk of the profitable business, the other kind can usually be left to take care of itself.

To come to what is perhaps the most important point to all of us—can gas illumination be made a subject of study and satisfactory, profitable engineering? If I were to answer the question in a few words, I would without hesitation say, yes, and add that I believe the gas situation offers more opportunities for good work than the electric. More and better illumination can be given for a dollar with gas than with electricity. With gas we are not pushed to the last limit by economy in its strictest dollar sense.

After all, when we look over the field we realize how little has been done and how

much is still to be accomplished. The surface has not been more than scratched.

Little has been said in the past about candle-power depreciation in mantles, and I have some figures here which were secured from tests of mantles of medium good quality. The efficiency from the initial to 100 hr. shows a drop of 11 per cent.; at 250 hr., 12.8 per cent.; at 500 hr., 27.2 per cent., and at 1000 hr., 33 per cent. This, by the way, is not greater than the depreciation in electric lamps by dust alone. Mantles from similar stock when subjected to tests on a bumping machine withstood an average of 1191 bumps.

On the maintenance proposition the gas companies have a condition which can be turned to their distinct advantage. Through this service you can better keep in touch with your consumers and sell illumination.

As an illustration of what this new kind of service means I might call attention to a city where we are somewhat familiar with the conditions. The old gas company had the field. The electric company were supplying lamps, both arc and incandescent to their customers, the only charge being that for current.

This forced the gas company to supply four mantle arcs and free maintenance. About the first of last July new interests took over a competing gas company which, having failed to make good, was forced into a change of management.

The new interests believing that the people would recognize the difference between purchasing gas, at so much per 1000, and illumination, selected the most efficient and scientific equipment known to the industry, not confining themselves to the conventional upright mantle gas arc.

The result. They have not only succeeded in putting the electric company very much on the defensive and cut into their revenue considerably, but have proved that illumination with gas at 90 cents per 1000 is a proposition meeting with greater success and more favor than obsolete arcs with gas at 50 cents per 1000. The latter being the point to which the old company have reduced their product in the mistaken idea that they are still selling gas and have little interest in its ultimate result—illumination. The placing of over 10,000 efficient inverted burners in the short period, July and October, many of them in positions and places where a gas arc of any kind could not possibly have been used—that is to say, in direct competition with small electric incandescent units. The additional gas sold, together with the well laid foundation for the sale of more gas, is an achievement which cannot be measured nor estimated, either by the number of burners put out or the present consumption of gas.

Illuminating Engineering Society Papers

Street Lighting by Tungsten Lamps, by S. G. Rhodes, presented at the January meeting of the New York Section.

The Theory of Flame and Incandescent Mantle Luminosity, by W. H. Fulweiler, presented at the January meeting of the Philadelphia Section.

Lamp Efficiencies—or the Efficiency of the System; Which? by A. L. Eustice, presented at the January meeting of the Chicago Section.

Some Unsettled Questions in Illuminating Engineering, by E. L. Elliott, presented at the February meeting of the New England Section.

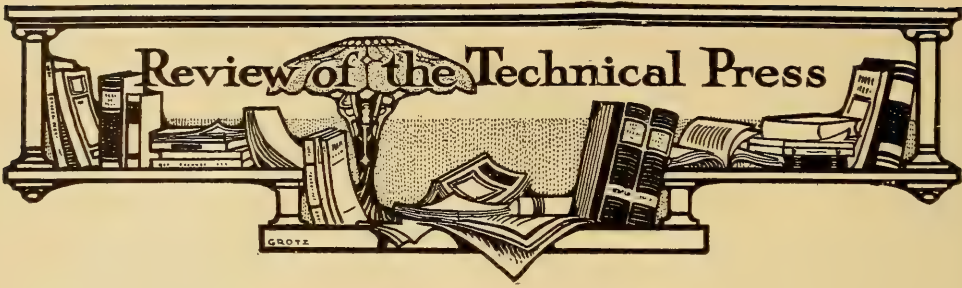
Specialized Gas Lighting, by T. J. Litle, Jr., presented at the February meeting of the Philadelphia Section.

The Comparative Practical Efficiency of Various Types of Gas Lamps, by R. C. Ware, presented at the December meeting of the New England Section.

Street Lighting, by Walter C. Allen, presented at the January meeting of the New York Section.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, SAN FRANCISCO SECTION.

Lighting with Metallic Filament Lamps, by E. L. Sherwood, presented at the San Francisco Section of the American Institute of Electrical Engineers.



American Items

Electric Lamps; by Maurice Solomon; 310 pages, 112 illustrations, 24 tables; cloth, $2.00 net; D. Van Nostrand & Co., New York.

The book does not aim to be a treatise on the subject, but is what might be called a popular technical description of the different forms of electric lamps that are now in commercial use, together with a short discussion of the subjects of the use of artificial light, and photometry. As the credentials of a scientific author are always of interest, the following quotation from the preface will be in order:

"With most of the lamps which have reached the commercial stage I can claim more than a bowing acquaintance, as I have been engaged during the last eight years in their manufacture, in the making first of Nernst filaments, later of carbon filaments, and finally in the manufacture of arc lamp carbons, with a brief digression into experimental work on metallic filaments. Most of the information given in this book has therefore been obtained first hand." . . .

The two essential qualities in a book of this kind are judicious selection of material, and a clear, yet accurate, presentation. Mr. Solomon seems to have produced both of these qualities to a marked degree. A book for the layman and for the busy practitioner may be as valuable for what it leaves out as for what it contains. The volume in discussion is not padded or overloaded with theoretical or detail matter which is only of casual or special interest. It contains all the information necessary on the subject of electric lamps for the practicing illuminating engineer, and for this purpose fills a place that heretofore has been void. We unhesitatingly recommend the book to all who have to deal with electric lighting, whether as illuminating engineers or interested in the purely commercial aspects of electric lighting.

Lighting a Modern Office Building; *Domestic Engineering,* April 3.

Deals with both the natural and artificial lighting of office buildings, but treats the latter as an electric wiring problem, rather than an illumination problem.

The Inaugural Illumination in Washington, by John C. McLaughlin; *Selling Electricity,* March.

An illustrated and descriptive article by the Chief Clerk of the Potomac Electric Power Co., Washington, D. C.

Lighting the Street and Store Front; *Dry Goods Reporter,* March 20.

An illustrated article dealing chiefly with special lighting effects in stores. The article is a strong exposition of the advantages of good illumination to the merchant.

Stair Lights, by "R"; *American Gas Light Journal,* April 5.

Shows several methods of lighting stairways by the use of glass risers with light-sources placed behind. The scheme is well worth the consideration of builders and owners.

Some Principles of Street Illumination, by Dr. Louis Bell; *Electric Review and Western Electrician,* March 13.

An exceedingly pithy and readable arti-

cle, impossible to abstract. The following quotations will indicate its character:

The fundamental purpose of street lights is to illuminate the streets to a degree adequate for the purposes of their use. If a street is an evening thoroughfare crowded with passing throngs and active in business, it needs and ought to have good lighting, not merely enough to blunder about in, but enough to enable one to see his friends easily, to read numbers and signs freely, and even to consult his notebook or pocketbook without having to walk a block to the nearest light. Streets used mainly for residence purposes and with only moderate traffic after dark do not need so strong lighting, but still must have enough by which to see one's way, to recognize people, and to walk or ride comfortably without peering about in order to see things. Such streets also need for police purpose light enough readily to disclose prowlers and to discourage their activities. On the other hand, there are many sparsely populated districts in which even this secondary degree of lighting is unnecessary and the lights have merely the function of markers of the way to enable passersby to avoid obstructions and to make out their whereabouts. These distinctions are practical ones, and it is to the neglect of them that much inadequate illumination is to be charged.

Until within the year just past there has been practically no street lighting of the first order in American cities. Even now the streets lighted anywhere near up to the common foreign standard are rare. In New York, Philadelphia, Baltimore, Denver and a few other smaller but enterprising cities there are now examples over limited areas of lighting that may well be imitated elsewhere. In one or two instances the illumination has been even a bit overdone through excess of enthusiasm. In several instances the particularly commendable improvement of using opal globes, universal abroad, has been at the same time introduced. If high power arcs are used the opal globe is almost a necessity in order to keep down the glare. A street lighted with naked arcs at the end of each long block is notoriously hard to drive through and produces an effect altogether unpleasant. A very thin opal globe reduces the trouble and at the same time greatly diminishes the shadows near the lamps.

LIGHTING BY VAPOR LAMPS, by Edson R. Wolcott; *Electric Review and Western Electrician,* March 27.

This is chapter VI. of part III. of a series of articles on Alternating Currents and Their Applications. Describes very briefly the principles of the Cooper Hewitt Lamp and the Moore Vacuum Tube.

ELECTRIC LIGHTING IN BAHIA, BRAZIL, by A. H. Keleher; *Electrical World,* March 11.

Illustrates and describes the lighting in this South American city.

A VOLT SCALE FOR WATTS-PER-CANDLE METER, by Herbert E. Ives; *Electrical World,* March 25.

Describes the apparatus and methods used at the Bureau of Standards.

THE CHICAGO ELECTRIC SHOP; *Electrical World,* March 18.

Elaborately illustrated article describing the show-rooms of the Commonwealth Edison Company.

ELECTRIC SIGNS ON ATLANTIC CITY'S BOARDWALK; *Electrical World,* April 1.

Describes and illustrates some of the principal electric signs at this well known resort.

LIGHT AND ILLUMINATION; *Light,* March.

This is the title of a department introduced for the first time in the March issue of this magazine. The editor confesses to having struck a snag in the selection of a title for the department, as the following quotation will show:

We have been watching the trend of the times with a view to determining just how best to handle in these columns the subject of illumination. At first we were tempted to view the subject from the standpoint of engineering in the illuminating field, but upon further consideration it seemed best to establish in *Light* a department for those who would study the simple, practical methods in illumination and the simpler ways to accomplish effects and results, rather than to talk from the standpoint of the engineer to the graduate. Therefore, we have determined upon the conduct of a department not to be entitled department of illuminating engineering, but "light and illumination."

On the whole this was perhaps the wiser course for a purely trade periodical to take. The department will be conducted by Mr. Albert J. Marshall. In chapter I. Mr. Marshall discusses: "Simplicity in Expression," "Both Practical and Theoretical," "Defining Light" and "Illumination and Effect."

Foreign Items

Compiled by J. S. Dow.

ILLUMINATION AND PHOTOMETRY.

Sul Calculo dell' illuminazione prodotta dalle superfici diffondenti, by U. Bordoni (*Atti della Asso. Elettrot. Ital.,* March-April, 1909).

A mathematical examination of diffused illumination and the Cosine Law.

Notes on the Exhibits at the Berlin Exhibition of Shipbuilding, by W. B. von Czudnochowski (*Illuminating Engineer,* London, March).

A description of the exhibits relating to light-house illumination. These include various automatic group-flashing and other devices, and gas, oil and electric lamps for use with searchlights, etc.

Editorials. The Standardization of Lighting Units (*Electrician,* March 5). The International Unit of Light (*Elec. Engineer,* March 5).

These editorials comment upon the announcement of the International Electrotechnical Commission that a sub-committee has been formed containing representatives both of gas and electric lighting, for the purpose of discussing in detail the proposed international unit of light; some important decisions on this point are expected shortly.

Modern Methods of Illumination (4) General Problems in Illumination and Illumination Measurements, by L. Gaster (Cantor lecture delivered before the Royal Society of Arts, March 8).

This last lecture dealt with applications of light for the purpose of illumination. Special reference was made to the necessity for screening sources of light; the source itself ought to be regarded as the crude product until properly shaded, and the lecturer thought that the matter was so vital that it might well be made the subject of government action.

Stress was also laid upon the desirability of adequate supervision of the lighting of schools, libraries, factories, etc., good lighting being, like food or air, a necessity.

Several striking experiments were performed illustrating the nature of the ultra-violet rays in illuminants, and the qualities of the "Euphos" glass, invented by Drs. Schanz and Stockhausen, which, it was claimed, was practically transparent to visible rays, but opaque to those of the ultra-violet variety.

An Integrating Photometer, by H. Krüss (*G. W.,* March 13, translated from the *Journal für Gasbeleuchtung*).

This article was mentioned after its appearance in the German magazine; it deals with a form of integrating photometer in which a series of inclined mirrors, supplemented by lenses, are utilized.

Considerations sur l'Eclairage des Ateliers au moyen de la Lumiere Artificielle, by P. Rosemberg (*Rev. des Eclairages,* March 15).

An account of a report presented to the Conseil de la Seine, on the subject of factory lighting. Although the report seems to confine itself to recommendations without at the present stage definitely prescribing regulations, this is interesting as an emphatic public recognition of the importance of supervision of the *lighting* of factories as well as the ventilation, etc.

Illumination, Its Distribution and Measurement, by A. P. Trotter (Continued; *Illuminating Engineer,* London, March).

The present section of this article deals with the Lummer-Brodhun Photometer.

The Use of Mirrors in Photometry, by L. Wild (*Illuminating Engineer,* London, March).

Bestimmung der mittleren hemisphärischen Intensitat einer Lichtquelle, by E. W. Weinbeer (*Elek. Anz.,* March 11).

A summary of different methods of cal-

culating the mean hemispherical and mean spherical candle power of illuminants from their polar curves of light-distribution.

EDITORIAL, ILLUMINANTS AND ILLUMINATING ENGINEERING (*J. G. L.*, March 16).

Discusses the decision to form an Illuminating Engineering Society in Great Britain, and reviews the work of the society in the United States. Notwithstanding the interest and value of the papers presented in America, the writer fears that the impartial illuminating engineer, capable of weighing the merits of all illuminants is not yet likely to be available, most of the papers presented dealing with one particular aspect; time is necessary for the architect, gas or electrical engineer, or medical man, to modify his own special standpoint sufficiently to lead to the development of the required expert. The writer, however, views the formation of the society with sympathy.

ELECTRIC LIGHTING.

ETAT ACTUEL DES LAMPES A INCANDESCENCE A FILAMENT METALLIQUE, by A. Blondel (*Bull. Soc. Int. des Electriciens*, February, 1909).

Covers similar ground on the subject of the metallic filament-lamps to the communication of the author to the Electrical Congress in Marseilles in 1907; this latter paper has been previously referred to.

NIEDERVOLTIGE METALLFADENLAMPEN UND IHRE VERWENDUNGSGEBIETE, by O. Brandt (*Z. f. B.*, March 10).

Discusses the peculiar advantages and applications of the low voltage metallic filament lamps. The author presents life curves of tungsten lamps compared with carbon filament lamps run at 3 watts per Hefner, and points out the value of the metallic for use on motor-cars and street signs, etc.

ZWEITEILIGE EDISON-STOPSEL MIT DURCHMESSERABSTUFUNGEN, by W. Klement (*E. T. Z.*, March 18).

Points out the weaknesses of the ordinary Edison cap and describes two recently introduced modifications of the Siemens-Schuckert Co., in which these defects are claimed to be avoided.

COMPARAISON DES LAMPES A FILAMENT DE CARBONE AUX NOUVELLES LAMPES A INCANDESCENCE A RENDEMENT ELEVE, by C. Leonard (*Lumière Electrique*, February 6, 13).

A complete general article on metallic filament and carbon electric incandescent lamps.

RESULTATS D'ESSAIS EFFECTUES AU LABORATOIRE CENTRAL D'ELECTRICITE SUR LES LAMPES A FILAMENT METALLIQUE, by F. Laporte (*Bull. Soc. Int. des Electriciens*, February, 1909).

Describes tests on metallic filament lamps. The author considers life-tests on metallic lamps as only of limited value in practice; the lamps almost invariably give way *before* losing 20 per cent. of their initial candle power, and, in practice, vibration and voltage fluctuation seriously prejudice their performances.

UNTERSUCHUNGEN AN GLÜHLAMPEN, by K. Sartori (*Elektrot. u. Masch*, March 7).

A very complete article on the new incandescent lamps, containing an interesting diagram connecting candle power and useful life with change in voltage. The author does not believe in "over-running" tests of useful life. He also enters into the theory of the radiation of metallic filament lamps, maintaining that their high efficiency can only be explained on the basis of selective radiation.

SULL'AZIONE DELLA CORRENTE ALTERNATA SULLE LAMPADA AD INCANDENZA CON FILAMENTI IN TANTALIO, by O. Scarpa (*Atti della Assoc. Elettr. Ital.*, January-February, 1909).

Describes some experiments on the effect of alternating currents upon tantalum filaments; the author ascribes the effect to the alternate attraction and release of adjacent filaments carrying the current.

ELEKTRISCHE HANDLAMPEN FÜR INDUSTRIELLE UND GEWERBLICHE BETRIEBE, by W. Vogel (*E. T. Z.*, March 4, 11).

Describes the conditions with which a

safe hand-lamp ought to comply and indicate some methods by which these requirements can be met.

EDITORIAL, THE COMPARATIVE COSTS OF GAS AND ELECTRIC LIGHTING (*Elec. Rev.*, March 19).

THE NEW EXCELLO ARC LAMP (*Elec. Engineering*, February 25).

SIXTEEN CANDLE POWER TUNGSTEN LAMPS (*Elec. Engineering*, February 25).

THE ECONOMICAL POSSIBILITIES OF LIGHTING BY CARBON FILAMENT LAMPS (Continued; [See also correspondence on this subject], *The Illuminating Engineer*, London, March).

GAS, OIL, ACETYLENE LIGHTING, ETC.

MODERN METHODS OF ILLUMINATION (3) LIGHTING BY OIL, ACETYLENE, ALCOHOL, PETROL-AIR AND OTHER PORTABLE METHODS, by L. Gaster (Cantor lecture delivered before the Royal Society of Arts, March 1).

In this lecture the speaker dealt first with simple illuminants, such as candles and oil lamps, etc., pointing out that these were still used in certain cases where custom and religious or historic association dictated their use; in addition the oil lamp, if properly looked after, had certain definite advantages for house lighting, and had formed the subject of discussion at the International Petroleum Congress at Bucharest in 1907.

More recently a marked improvement in portable lamps had been effected by utilizing the incandescent mantle and the Petrolite, Blanchard and other lamps were exhibited as illustrations of this principle.

Petrol-air systems were also described, several complete working plants being on exhibition.

Acetylene lighting was also on exhibition; special mention was made on dissolved acetylene and its use for buoys, railway trains, etc. In this connection much interest was exhibited in the Dalen automatic flashlight and solar radiation valve shown.

In conclusion the lecturer dealt briefly with the relative costs of different illuminants, pointing out the misleading character of many such tables put forward. He also completed his lecture by a short *résumé* of the theory of radiation underlying the production of light.

HIGH PRESSURE GASLIGHTING, by V. M. Evans (*J. G. L.*, March 16).

KEITH PRESSGAS, by Finck (*Z. f. B.*, February 28).

SOME INDUSTRIAL USES AND POSSIBILITIES OF ACETYLENE, by A. F. Jenkins (*Acetylene*, March).

RETURNS OF GAS TESTINGS IN LONDON (*J. G. L.*, March 9).

ACETYLENE NOMENCLATURE (*Acetylene*, March).

NEUE INVERTBRENNER (*Z. f. B.*, March 10).

LUFTGAS UND ACETYLENE (*Z. f. B.*, March 10).

This article is a rather interesting comparison of the merits of compressed oil-gas, etc., and acetylene; the author is chiefly concerned to justify oil-gas against the reproach of being subject to condensation in cold weather. This, he says, was only a characteristic of the older systems, and does not take place in the case of the "poorer" mixtures now used; for instance, some plants in Germany have been successfully used when the temperature was as low as 10 degrees without mishap.

AN UPRIGHT MANTLE WITHOUT A PROP (*G. W.*, March 13).

L'ECLAIRAGE DES EGLISES PAR ACETYLENE (*Rev. des Eclairages*, February 28).

MEISTER-ZÜNDER FÜR HANGENDES GASGLÜHLICHT (*J. f. G.*, March 13).

GAS "ARC" LIGHTING ON A LARGE SCALE (*J. G. L.*, March 16).

Contractions utilized:
Atti della Assoc. Elettr. Ital. *Atti della Associazone Elettrotecnica Italiana.*
Bull. Soc. Int. des Electriciens. *Bulletin of the Société Internationale des Electriciens.*
Elec. Rev. *Electrical Review (London).*
Elek. Anz. *Elektrotechnischer Anzeiger.*
Elektrot u. Masch. *Elektrotechnik und Maschinenbau.*
E. T. Z. *Elektrotechnische Zeitschrift.*
Illum. Eng. Lond. *Illuminating Engineer of London.*
G. W. *Gas World (London).*
J. f. G. *Journal für Gasbeleuchtung und Wasserversorgung.*
J. G. L. *Journal of Gaslighting (London).*
Z. f. B. *Zeitschrift für Beleuchtungswesen.*

The Illuminating Engineer

Vol. IV MAY, 1909 No. 3

A CARNIVAL OF LIGHT

"Men are but children of a larger growth."

We Americans are a great people, but we have one besetting sin: we take ourselves and life too seriously. As soon as we are out of the cradle we start on a dead run for the grave, and reach it breathless from haste and without a single cheerful vision of the scenes that we passed on the way.

The most important and valuable lesson which as a nation we have yet to learn is to enjoy life while it is passing. We must learn to relax, to throw off the assumed cares and dignities of manhood, and at more frequent intervals become children again.

The carnival is an ancient and wise institution. Its harmless follies and effervescence of spirits are better than oceans of " tonics." Modern illuminants have enlarged the possibilities for festivities of this nature in two ways: they have made the night available, when even the most hurried business-man or workman can find leisure, and they furnish in themselves a means of an endless diversity of attractions.

Let us have at least once each year a Carnival of Light. Let it be held in the spring in celebration of the return of sunshine and warmth that invite to outdoor pleasures. Let it continue for a week; and let there be a generous rivalry among merchants, manufacturers, civic organizations, and private citizens as to which shall show the most striking, novel and effective use of light.

Consider what such a Carnival of Light would mean to the prosperity of your town; how many visitors it would attract; how much enthusiasm and public spirit it would awaken in your own townsmen; and how much permanent benefit would accrue from the demonstration of the value of better lighting.

We have not yet begun to realize the possibilities of our wonderful modern light-sources. Let us more fully appreciate that the discoveries of science can contribute to our leisure and our delight equally as much as to our facilities and opportunities for labor; otherwise it were better that we return to the primitive condition of the savage.

E. L. Elliott.

FIG. I.—TYPICAL STREET IN WARREN, OHIO.

Tungsten Street Lighting at Warren, Ohio

By J. D. Hoit.

Of the thousands of dollars spent annually in our cities for the purpose of public improvement, but a very small percentage of this amount has, until recently, been expended for the purpose of public street lighting. The American cities have for a long time awaited the introduction of a lighting unit which could be used to a greater advantage for street lighting, and since the advent of the high efficiency tungsten lamp the long felt want has disappeared, and to-day we are able to boast of better lighted streets than ever before. This process of substituting the new illuminants for the old has not been localized, but has been broadcast in its effect. This effect has not only been pleasing to the citizens and municipalities where such changes have been made, but has also been an aid to central stations in the development of new business.

The value and widespread operation of the tungsten lamp can better be judged when it is understood that this illuminant is being accepted to supersede all other form of street lighting ranging throughout the entire field of street illuminants.

While it is deemed unnecessary to take the time here to comment upon the various systems previous to the introduction of the high efficiency tungsten lamp, yet, for any one who is not familiar with this highly interesting subject, it would prove worth the time spent in investigation.

Some of the more enterprising merchants in various localities have recognized the advantages presented by this latest illuminant, and have, by its adoption, helped to increase their profits because of the excellent indirect advertising afforded. This form of lighting has been made artistic by the use of suitable and decorative standards which, besides serving their purpose at night, also add materially to the appearance of the street during the day.

In many instances where the ornamental standards have been proposed, the light-

FIGS. 2. 3. 4. 5

ing company, as well as other companies maintaining lines along the street, have joined in the enterprise and have eliminated such poles and overhead construction as has been possible, thereby greatly improving the general appearance of the street.

Another form of construction which is meeting with approval is the use of ornamental casings made and designed to fit around trolley poles. This form of construction has the advantage of adding strength and beauty to the trolley pole and does away with the necessity of placing more obstacles along the curb line.

Another method of construction used to some extent is the so-called "arch system." While this presents a very pleasing effect at night, yet, owing to the general spacing, a good, even distribution of illumination is seldom obtained.

In a majority of cases where the tungsten system of street lighting has replaced the former systems, the city has derived the advantage of far better lighted streets at the same relative total cost as that previously paid. The series tungsten lamp is by no means alone in its applications to this class of work, as the multiple tungsten lamp has also been effectively used in many localities. Where these various systems have been changed over for a tungsten installation, the selection of either multiple, or series, lamps has been determined by the conditions to be met.

In street lighting it is, at all times, essential to produce an even and well distributed illumination upon the streets and sidewalks. This illumination need not necessarily be of high (candle power) intensity. In selecting the amount of illumination required no definite figures can be given, inasmuch as the general value, or importance of the street, proves too variable a quantity.

By the application of the incandescent

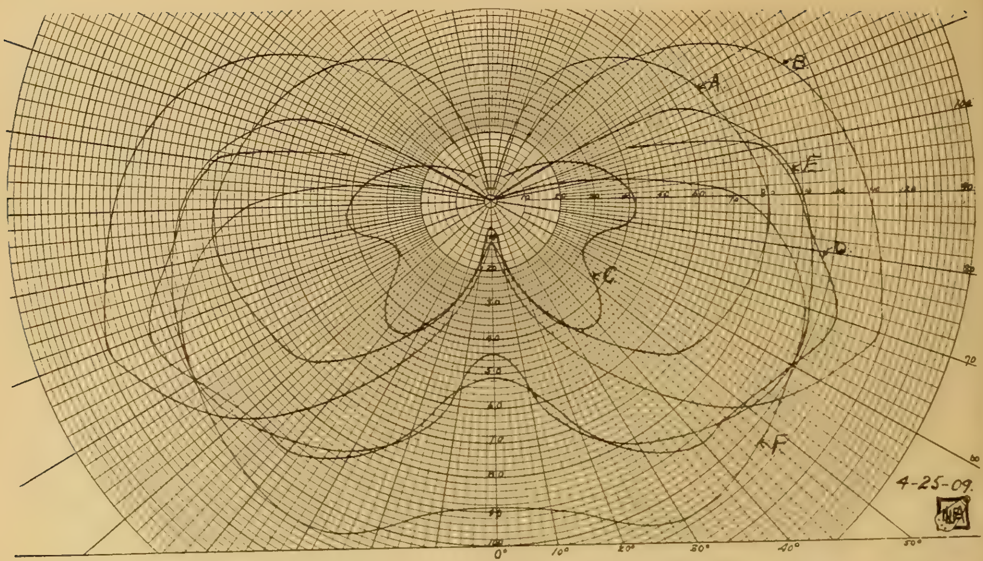


FIG. 6.—CHARACTERISTIC DISTRIBUTION CURVES. A. CLEAR TUNGSTEN STREET SERIES LAMP—80 CP. B. PRISMATIC GLASS REFLECTOR—STREET SIDE, 22½° FROM CURB LINE. C. PRISMATIC REFLECTOR—HOUSE SIDE, 22½° FROM CURB LINE. D. RADIALLY FLUTED METAL ENAMELED REFLECTORS. 18 IN. WITHOUT GUARD. E. 22 IN. ENAMELED STREET HOOD. F. 18. IN. ENAMELED FLAT TIN SHADE.

system of lighting this detail has been more effectively accomplished, especially when the important factor of wattage consumption for candle power distribution of the various electric street lighting systems are taken into consideration. In order to produce the best results it has been found advisable to equip the incandescent lamps with some suitable deflector, and to place the lamps at such heights that they are above the range of vision and at no time meet with the interference of foliage. While conditions vary greatly, it has been found preferable to place these lamps from 12 to 15 ft. above the center plane of the street. If placed nearer, the direct glare from the lamp is generally in the line of vision and proves very objectionable to drivers and pedestrians, and due to this blinding effect the liability of accident is greatly increased.

In general, a satisfactory incandescent street lighting system may be installed in either of the following ways:

1st. By the use of lamps of equal candle power and varying the spacing between them.

2nd. By choosing a standard spacing and by using lamps of different candle power.

The spacing and use of different candle power lamps will depend upon the importance and width of the street.

Of the two systems above referred to there is but little doubt that the former is the most applicable, as it necessarily embodies the use of fewer lighting units and also makes it possible for the central station to carry a smaller lamp stock.

The two methods of street lighting applicable in the use of incandescent lighting are: "Parallel," and "staggered." The latter system has proved the most effective and accepted for residential districts, while the former, especially where ornamental standards are used, is conceded preferable for the business districts.

The Engineering Department of the National Electric Lamp Association has quite recently prepared plans and specifications for a proposed tungsten street lighting system for the city of Warren, Ohio; and, in order to fully demonstrate the advantage to be gained over their arc system, an installation was made on one of their prominent streets and was typical of the installation proposed for that street, and all photographs and data included in this article have been obtained from this installation.

FIG. 7.—ONE OF THE TYPES OF STANDARDS.

The posts and standards used are the product of local manufacture. The posts were so designed that they would also serve the purpose of supporting the overhead wiring, as well as presenting a decidedly artistic appearance during the day.

Four types of reflectors were used.

Prismatic glass reflectors were placed on posts (as shown in Fig. 5) Nos. 1 to 4, inclusive. These reflectors are so designed as to distribute the light up and down the street, the maximum intensity being at an angle of 22½ degrees to the curb line.

Radially fluted enameled iron reflectors (Fig. 3) were placed on posts Nos. 5 to 8, inclusive.

Enameled iron looped hood reflectors (Fig. 2) were placed on posts Nos. 9 to 12, inclusive.

Flat tin shades (diameter 18 inches) (Fig. 4) were used on posts Nos. 13 to 15, inclusive. These reflectors are constructed of heavy tin, having the under surface brush enameled.

All of the metal reflectors have a circular distribution.

The relative distribution of the various reflectors used may more definitely be determined by reference to the characteristic distribution curves shown.

These posts were spaced approximately every 200 ft., "staggered," and the 80 c.p. series tungsten lamps used with the above mentioned reflectors were placed on 24-in. goosenecks and so located as to allow lamps to hang 1 ft. outside of curb line and 12 ft. above the center line of the street. These lamps were placed 20 in series on a 500-volt D.C. line and were maintained at 4 amperes.

Photometric measurements were confined to measurements of horizontal illumination at the street surface, and were carried out with the aid of a portable photometer of approved design. The test plate consisted of white blotting paper laid approximately with and about ½ in. above the street surface. The apparatus used was standardized by producing upon the blotting paper illumination of known intensity from a standard 25-watt tungsten lamp. These stations were located every 25 ft. along the street parallel to the curb line and readings were secured along the center line of each walk. Along each lamp line and along the center line of the street, all station readings were taken in a line perpendicular to curb line and approximately ½ in. above the surface and averaged .015 foot-candles throughout the entire length.

The street is 30 ft. between curbs and 66 ft. between property lines. A 6-ft. sidewalk is located about 7 in. above the gutter line and 1 ft. inside of property lines, the crest of the street being 3 in. above the gutter line. All houses along the street set back at such a distance that no reflection was received to affect the readings obtained. These illuminometer tests were made on a clear night and no moon.

The ornamental standards used in the demonstration are of the regular three-light variety having two pendant lamps on cross arms, and having a spacing of

FIG. 8.—STREET LIGHTED WITH TUNGSTEN LAMPS.

36 in. between centers. These pendant lamps are of 40 c.p. each and are protected by large glass balls of 8 in. diameter. The single light at the top of ornamental standard is of 80 c.p. and is protected by a 10-in. glass ball. These ornamental standards are to be spaced approximately every 100 ft., according to parallel system throughout the business portion, and so placed that the cross arms will be parallel to the curb line. The pendant lamps are to hang 12 ft. and top light about 13½ ft. above the sidewalk.

Lamps along one side of the most important residential streets as well as the top light on all ornamental standards throughout the business district shall be wired for all night burning. This has been found advisable instead of maintaining a complete all night system.

It will be noted from the accompanying photographs that the street where the installation was made is one that is heavily wooded on both sides. In the summer these trees form a regular canopy over the street and because of their low branches and heavy foliage practically shut off all light which was given from the arc. This condition is identical with the majority of streets in Warren. By the application of the tungsten lamps, this at one time serious condition has been completely overcome. The distribution as obtained can better be judged when the night photograph taken from the same position has been thoroughly studied.

The proposition at Warren which confronted the engineers was to furnish more and better light for about 255,000 lineal feet of sidewalk at the same total cost to the municipality. This was formerly covered by 158 arc lamps, which meant approximately one arc for every 1600 ft. of sidewalk. In some instances, however, this spacing was doubled. These arcs were operated at a cost of $10,820 per year, and when it is considered that each arc is only capable of taking care of 400 ft. of street or 800 lineal feet of walk, some comparison of the service received for an expenditure of this amount may be definitely judged. This would mean that from the 158 arcs only 126,400 of the total 255,000 lineal feet were receiving light, while the remainder was practically in darkness. These figures are based on conditions most favorable to the arc lamps and one can very readily draw conclusions as to the results obtained when they are operated under existing conditions.

In the entire installation approximately 1000 tungsten series lamps have been specified. This total, however, includes lamps placed on streets which were not formerly lighted, and also includes the lamps used on decorative standards throughout the business district.

In conclusion, it is essential to note that in selecting the most desirable method of street illumination, one must be governed entirely by the local conditions to be overcome, as the amount of illumination required varies in accordance with the locality.

Some Notes on the Historical Development of Street Lighting in London in the Seventeenth and Eighteenth Centuries

By a Correspondent.

I.

The history of the illumination of London's streets has yet to be written. To unravel the tangled threads, and to bring the dispersed elements involved in such a history into a clear and systematic narrative, is no easy task. In spite of the works of Stowe, Maitland, Seymour, Macaulay, Lecky, Walter Besant, &c., who occasionally have referred to this matter, and who may claim the distinction of pioneers, there still remain large tracts of untraversed territory, in the exploration of which the scholar has available but meager data. The following remarks are only intended as a preliminary and general survey of the lighting in London, chiefly in the seventeenth and eighteenth centuries, and mainly derived from the labors of the before mentioned investigators.

It is curious in our own days of gaslight and electricity to look back to those times, when "it was a common practice in this city that a hundred or more in a company, young and old, would make nightly invasions upon houses of the wealthy to the intent to rob them and that when night was come no man durst adventure to walk in the streets."

It was an age of lawlessness, when only a candle with a cotton-wick was suspended here and there from six to eleven o'clock on dark nights; it was a time of lanthorns, flambeaux, and linkboys, when everybody signed his will and was prepared for death before he left his home. Forgotten were the bonfires on May Day and Midsummer Eve of Henry VIII., when the streets were full of light, when, over the doorways of the houses, oil-lamps actually burned all night through.

In 1415 the first attempt at regular lighting of the streets of London was made when the Mayor, Sir Henry Burton, ordered householders to hang out lanthorns in the winter evenings betwixt Allhallows and Candlemas (*i. e.,* the festive season).

For three hundred years afterwards the citizens of London were, from time to time, reminded, on pains and penalties, to hang out their lanthorns at the appointed time; for, after curfew, the town appeared practically lifeless. For the securing of houses against robbers and thieves, for the prevention of murder and the convenience of passengers, the watchman with his long coat, halberd in hand, and lanthorn, passed the street crying out:

"A light here, maids, hang out your lights,
And see your horns be clear and bright,
That so your candle clear may shine,
Continuing from six till nine;
That honest men that walk along
May see to pass safe without wrong."

In 1668 all the inhabitants of London were ordered "for the safety and peace of the city to hang out candles duly to the accustomed hour." In 1679 the Lord Mayor proclaimed among other things: ". . . . the neglect of the inhabitants of this city in hanging and keeping out their lights at the accustomed hours, according to the good and ancient usage of this City and acts of Common Council on that behalf." But still "when nights

darkened the streets then wandered forth the sons of Belial, flown with insolence and wine," and so the Act of 1676 was renewed in 1690. Every housekeeper had to place a candle or a light, on moonless nights, from Michaelmas to Lady Day, "excepting such person or persons as shall agree to make use of lamps of any sort, to place at such distances in the street, as shall be approved by the justices of peace."

It ought to be remarked that at that time an ingenious projector, named Edward Heming, obtained letters patent conveying to him, for a term of years, the exclusive rights of lighting up London. He undertook, for a moderate consideration, to place light before every tenth door, from Michaelmas to Lady Day, and from six to twelve o'clock. Although Heming's lanthorns glimmered feebly, he really had done a good deal to illuminate and guard the city, and to banish nocturnal shadows. Nevertheless his contemporaries attacked him furiously, and the license granted in 1694 to certain persons "concerned and interested in glass-lights, commonly called or known by the name of convex-lights" was withdrawn in 1716.

The city had again many districts where no light was to be seen. In 1716 every housekeeper whose house fronted any street or lane and was rented at £10, and every person having the charge of a public building, was required and obliged, on penalty of a fine of one shilling, during every dark night, from September 29 until March 25, to hang out one or more lanthorn or lanthorns with sufficient wick-candles lighted therein, and to continue the same burning in every such dark night, from the hour of six until the hour of eleven o'clock of the same night.

This method of lighting the streets at night was soon found to be very inadequate and insufficient, because (1) most of the inhabitants were not rated up to £10, and (2) the limited period of time during which the streets were lighted were found to expose the citizens to the depredations of street robbers and house-breakers. After eleven o'clock the city was practically in total darkness. The shops, which were kept open till eight or nine o'clock in the evening, alone made the streets agreeable for these few hours, so that Defoe in 1729 published a pamphlet wherein he demonstrated his plan, according to which our streets were to be so *strongly guarded* and so gloriously illuminated that any part of London would be as safe and pleasant at midnight as at noonday, and burglary totally unpracticable.

Up to 1736 the lighting was done by contract, and the contractors, by a singular arrangement, agreed to pay the city £600 a year for their monopoly. In return for this they were empowered to levy a rate of 6 shillings a year upon all housekeepers who paid poor rates, and from all who had houses of over £10 per annum, unless they hung out a lanthorn or a candle before their doors (see above).

As this private undertaking became a good job for the contractors, and the robberies increased in 1736, it was thought needful to apply to Parliament for powers to light the streets in a more effectual manner, and to take the lighting of the city out of private hands. An act was accordingly passed, by which the city was empowered to put up lamps where they might think fit, to burn from sunset to sunrise. And to bear the expense of this lighting a rate was imposed of 7 shillings on every house under the rent of £10 per annum; of 10 to 20 shillings on houses at £12 per annum; of 20 to 30 shillings on houses at £14 per annum; of 30 to 40 shillings on those at £16, and not more than 40 shillings on houses of a higher rental. Instead, therefore, of a thousand lamps, the number was now increased to 4679; but as these even were not sufficient several of the wards made a considerable increase, so that the whole could amount to no less than 5000.

This, however, was only the amount in the "City and Liberties," and does not include the suburbs. In 1738 it was estimated that the whole number of lamps was about 15,000. The time of lighting also, which before had been only 750 hours annually, was increased to 5000. In 1739 and 1744 this act was enlarged, and made more stringent owing to the great number of robberies committed in the streets during the night. I mention "the officious linkboy's smoky light," and

the dim light of the theatres and taverns, and turn again to street lights.

The age of lamps was approaching. The city made another and more important step in 1762. In that year the Westminster Paving and Lighting act was passed. The days of the lamp lighters began (see Hogarth's wonderful picture, "The Rake's Progress," reproduced on the front cover) with the tin vessel containing oil, till also this feeble glimmering light was superseded by the introduction of gas, first adopted in London's streets in 1807.

(To Be Continued.)

Indirect Illumination

By Augustus D. Curtis.

Certain illuminating engineers and theorists who are not conversant with the latest developments in indirect illumination, or who have not even seen installations of this method along the most recent lines of endeavor, have taken occasion to covertly attack, criticise and make fun of this method as recently applied, at the same time acknowledging that they have not personally come in touch with these developments. Such articles seem uncalled for and unjust. They are no credit to the authors, and I predict that in a short time, when indirect illumination has come into its own, and when not thousands but millions of people are experiencing the comfort and blessings of indirect illumination, they will recall with regret their efforts to belittle the advancements now being made along this line.

It is needless for me to go into the theory of this method of illumination, or to explain why certain criminals went insane in circular prisons hundreds of years

FIG. I.—INDIRECT LIGHTING AT THE KENWOOD CLUB, CHICAGO.

ago; it is more pertinent, practical and sensible to ignore such covert attacks and simply state for the benefit of your readers and the thousands of those who are interested in indirect illumination that it is now no longer a theory, but that it has been worked out in its practical application, made commercially available, and is a demonstrated success. Not one person who has worked under this method of indirect illumination in its recent application but is an enthusiast in its praise. Were no financial remuneration for the time and expenditure made in working out this problem received by those responsible for these developments, they would feel amply repaid by the great comfort and benefit conferred upon those who are now working under this system. "The proof of the pudding is in the eating," and the proof of a lighting system is the satisfaction and comfort it gives the users.

The accompanying illustration shows the library in the Kenwood Club, Chicago, one of the oldest and most aristocratic clubs in the city. This library is 28 x 30 feet. They previously lighted this room with fourteen 16 candle power carbon filament lamps; eight around the walls and six on upright sockets of the combination fixture, as shown, in the center of the room. The illumination was very unsatisfactory and the only places a person could read with any degree of comfort were under the three wall lights, as shown. The illustration shows "adaptables" applied to the center chandelier. Each contains a 60 watt tungsten lamp, producing an even distribution of light, by which one can read in comfort in any part of the room. Besides the room shown this club has installed the same system in the card rooms, where the results are also extremely pleasing to the members. A number of clubs are installing this method of illumination, among them the Strollers' Club of New York City.

The American Radiator Company, having salesrooms and offices in all large cities in the country, have adopted indirect illumination in their two buildings on Michigan avenue, Chicago, and are also installing same in their St. Louis and Detroit places of business. This method of illumination is meeting with favor in office buildings, where there are usually certain number of offices that are difficult to rent on account of their being inside rooms. Many large counting houses have or are making installations of this system, as the glare from the highly glazed papers and ledgers is entirely done away with, and it is estimated that 20 per cent. more work under artificial illumination is accomplished than with working under direct lighting.

To show what some of those who have installed indirect illumination think of the system may be interesting.

The Chicago Beach Hotel has installed this method of illumination in the dining room with very satisfactory results. Mr. Gray, manager of this hotel, states:

"We have had nothing but compliments from the guests who are using this room. Before the installation of these fixtures we were using 16 candle power carbon filament lamps and were using 2240 watts. The four new fixtures with twelve 100 watt tungsten lamps are consuming 1200 watts, making our saving 1040 watts. The saving in current does not compare with the great satisfaction to our guests of this system of illumination, and I predict a great future for illumination of this kind."

Almer Coe, the well known optician, states:

"We have had but a month's trial of the system of indirect illumination, but now feel that we should under no circumstances like to go back to the old methods (and we have tried several). Present day systems of lighting—that is, by large volumes of light emanating directly from powerful units—are all subject to the same serious objection in that it is practically impossible to place these units out of direct line of vision. This direct lighting, of questionable quality at best, falling upon the eyes from highly iuminous sources, and for long periods, is conceded to be most harmful to eyes and a severe tax on our nervous energy. The writer believes that by proper illumination by indirect methods—that is, by reflectors obscuring completely all direct sources of light—that besides removing the source of much eye distress and frequent headaches, energy is conserved,

tendency to irritability is lessened, and that one working under such conditions must be physically and mentally better at the day's end."

The results found by practically all those who have installed this method of illumination in their counting rooms can be expressed in the words of one of the companies using it (Requa, Enger & Co.), who say:

"The system of indirect illumination produces a more satisfactory diffusion of light than we had supposed it were possible to secure by artificial illumination. It is the nearest approach of daylight we have ever seen produced by artificial means. The great comfort derived from its use makes us feel under personal obligations to you for having at last perfected indirect illumination. We have almost entirely done away with individual desk lighting and every nook and corner of our office is evenly and well illuminated. The glare on our ledgers and papers previously experienced from the direct system we had is entirely done away with."

One store on La Salle street, Chicago (Hartzell-Lord), express themselves in this manner:

"We had recently installed sixteen 40 watt direct tungsten lights, which were replaced by your system, and, while we are obtaining fully as much light as formerly, the same is now evenly distributed and the absence of any glare is noticeable. We might also add that the wear and tear on the eyes (such as headaches) has been remedied altogether, and we cannot speak too highly of this system."

Mr. H. H. Windsor, the editor of *Popular Mechanics,* writes as follows:

"The lights installed in my private offices are affording such a relief to the eye strain that I feel impelled to make an exception to a rule that has not been broken in many years, and to offer this voluntary tribute. The system sheds a light which combines, as I have never before experienced, the strength of noonday sun with the soft glow that comes to snow-capped mountains at sunset. The room itself does not appear to be unusually well lighted, but when one had occasion to read fine print in any part or corner, then it is he realizes its efficiency and charms, and surprise gives place to permanent satisfaction. It has certainly taken from the electric light that harshness and severity which inventors have been seeking to eliminate ever since the first electric arc flashed forth."

Chickering Brothers, piano manufacturers, state:

"Results with the indirect system have been eminently satisfactory, and visitors are greatly impressed with the soothing effect of this light. Our employees find the light superior to anything we have ever had. It has been the means of expediting our work very perceptibly."

The foregoing expressions from a few of the users of indirect illumination in its most recent development express the general opinion of thousands who are working under its pleasing influence. Over 1500 indirect lighting units have been installed since this system was presented through the Illuminating Engineering Society last October. It is now quite generally acknowledged that indirect illumination is at last commercially available; that it is no longer a theory or an experiment, but a proven success.

In consequence, architects are more than ever going into this method of illumination, realizing its great desirability. D. H. Burnham & Co., the well known architects, have installed indirect illumination in their offices and, with specially designed art glass bowls containing the inverted units, have secured very artistic results. In the lighting of large auditoriums, architects have long been looking for a practical solution of the problem. Marshall & Fox, architects of the new Maxine Elliott Theatre, New York, are now installing in the large auditorium of the South Shore Club, Chicago—a building approximately 90 x 115 feet, 28-foot ceiling—indirect illumination, using three large specially designed chandeliers, each containing inverted units to contain 100 watt tungsten lamps.

The lighting field is so large, its interests so varied, and the advancement in it so great that perhaps it is more charitable to think that the critics of indirect illumination are so busy with their own grinding that they have not had the time or opportunity of thorough investigation before rushing into print.

FIG. 1.

Growth of the Electric Sign

By T. I. Jones.

Starting with a simple formation of outline letters made up of incandescent lamps, the electric sign has developed into enormous proportions with the production of most striking effects; and the end of its development is not yet in sight.

The value of a sign naturally depends upon the number of people who see it; probably more people pass the corner of Broadway and Forty-second street, New York, between the hours of sunset and sunrise than any other spot on the American continent. It is natural, therefore, that every available location in this vicinity for an electric sign should be occupied.

Fig. 1 shows one of the largest and most striking signs recently erected, being located on top of the old building now standing opposite the Times Building, at the intersection of Seventh avenue and Broadway with Forty-second

FIG. 2.

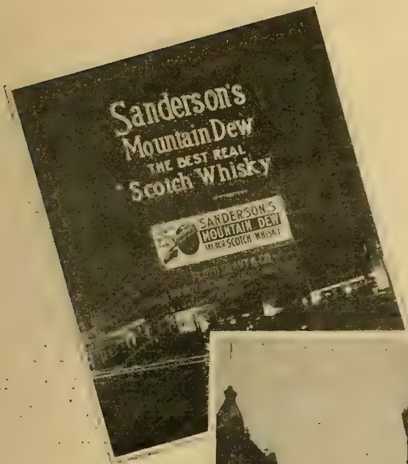


FIG. 3.

street. The sign is in colors, and has one change. The lettering all goes out, together with the outline indicating the lower frill of the petticoat, leaving only the upper frill and the ankles and feet showing. The size of the sign can be appreciated by comparing it with the size of the building, an old-fashioned four story structure. The sign is 70 feet long and 55 feet high, and contains 1867 lamps.

The sign shown in Fig. 2 is noticeable for the exquisite blending of colors and the daintiness of design. The leaves and fruit are shown in their natural tints. The designers of this sign have received letters of commendation and inquiry from all over the world.

Fig. 3 shows the two changes of another sign, its position covering the entire front of a building facing Long-

FIG. 4.

acre Square. The Scotch plaid background is formed in colored lamps. The sign contains 1793 lamps.

A little further down Broadway is located the sign which goes through three changes, as indicated in Fig. 4. The line running up to the "$100" is in red, and as it runs up, the "$100" changes to "$65," and the word "old" into "new." This is followed by the appearance of the entire wording of the sign. Lamps of three different colors are used to make up the sign.

Light Tinted Symbols on Dark Backgrounds in Printing

By Albert J. Marshall.

Custom—common usage—is something which every new idea and thought must battle with and overcome before recognition of a broad and public nature can be hoped for. Even in this day of wonderful scientific achievements, in many instances we take too much for granted; the result being that in many cases a method which we have accepted as correct proves, upon investigation, to be the reverse. An example of such usage, to my mind, is the common method of printing by black lettering on white surfaces.

The use of black lettering on white surfaces has been handed down to us from time beyond recall, until we have begun to look upon it as absolutely fixed; we accept it simply because our forefathers and their forefathers used such a method. The use of this method was, in all probability, brought about by the fact that it is an easier matter to make a marking fluid which was of a black or dark color than to produce a light colored fluid. With the advent of the printing press and the use of type further use was made of dark fluids. So far as the writer has been able to ascertain, there appears to be no scientific reason why the method should ever have been put into use other than this, or why it should remain.

I am convinced as the result of experiments during the past several years, and from a consideration of the simple theory of vision, that the method of using *light tinted* symbols on *dark* backgrounds is far preferable to the present method of *black* symbols on *white*. I here call attention to the fact that I recommend *light tinted* symbols on *dark* backgrounds, and not *white* symbols on *black* backgrounds; in the early stages of my experimental work I convinced myself that *white* on *black* was not only unnecessary, but is rather injurious to the eye, because the contrast is too great. This statement, however, does not hold for display work, where severe contrasts are desirable.

I have experimented with a large number of combinations of tints, or shades of colors for *light tinted* symbols on *dark* background, and the most generally satisfactory combination that I have thus far been able to obtain is amber or yellow symbols against a dark green background. Yellow is perhaps one of the most acceptable colors to the eye, coming as it does in the middle of the spectrum, while green is used generally in nature for the eye to rest upon. I am, however, not prepared to state that this combination is the best possible one, as I have not yet concluded my investigations in this direction.

In advocating this theory I fully appreciate the fact that to attempt to put it into general use on the spur of the moment would be absolutely wrong, inasmuch as the eye, having become (forcibly) accustomed to the present method, would not be able to at once adjust itself to the proposed system; but by a slow process of evolution, which I am firmly convinced will be brought about, the eye will naturally adjust itself to the change and benefit accordingly.

The theory underlying the proposed method may be summed up as follows:

It is common knowledge that in order to "see" an object, light rays must be reflected from the object to the retina of the eye. Therefore, when we look at a page of printed matter done in the present method of black on white, what we actually "see" is the white or light *background,* and (*indirectly*) the letters, purely and solely by contrast, inasmuch as the

white or light background reflects light, while the printing, being in black, may be considered as absorbing all light rays falling upon it. It, therefore, will be understood that in order to "see" in our present style of printing, the eye must receive light rays from the page as a whole, minus that taken up by the type—an area which is usually many times greater than the combined areas of the letters, thereby stimulating the eye far beyond what is necessary. In the proposed method the eye "sees" exactly what it needs to see, not the background, but the light tinted symbols themselves, which reflect light to the retina of the eye, while the dark background absorbs the light falling upon it.

This method may be compared to a jeweler's window, where the bottom is covered with black velvet, on which is displayed jewelry, precious stones, etc. When you look into such a window you are not interested in the black velvet (background), but in the goods, which for our purpose may be considered as printing. Take as another simple illustration the method of writing with white chalk on blackboards, as is customary in public schools; you will recall that it was a comparatively easy matter to "see" writing done in such a manner. Such illustrations are numerous.

In my experimental work I have attacked this theory primarily from the physiological standpoint. My knowledge of the purely practical and economical sides as to printing and manufacture of paper are rather meager. It will perhaps be of interest, however, to note that this theory seems to offer a solution of the problem of saving the forests from an early total destruction, the trees in which are being cut down to manufacture the paper that is used for printing of newspapers. News paper once used, as at present, is of little or no value for printing again, inasmuch as the ink used is composed of oils and gum, and resists all bleaching processes. With the use of the proposed method of light symbols on dark backgrounds newspapers could be used over again, perhaps many times. It appears that it has been a somewhat difficult matter to obtain highly satisfactory light or white inks, but this difficulty could and would be overcome if the demand was sufficiently great.

A study of statistics with reference to the alarming increase of defective eyesight will also be an incentive, I think, for reasonable thought being given to the proposed theory. For instance, in Vermont, of the school children's eyes that were examined, 34 per cent. were found to be defective; while in New York City, out of 58,948 children examined, 17,938, or about 30 per cent., had defective vision. Dr. Hermann Cohn, of Berlin, states that defective vision is becoming more prevalent with the increasing tax on the eye by more study; among pupils who had remained at school the full fourteen years, 63 per cent. had defective eyesight. A report of Dr. Maximilian Bondi supplies similar high figures.

While, of course, defective vision is largely due to the wrong use of natural and artificial light, both in schools and at home, yet I am thoroughly convinced that a goodly share of such defective vision could be materially eliminated by the use of what seems to me a more reasonable method of printing. This can be appreciated when one considers the amount of study that the ordinary pupil is supposed to undergo, where the eye is generally compelled to look, for a long period of time, at comparatively large white surfaces in order to "see" print.

Until such time as the proposed method can be put into use, it seems that we should, at least in school books, get away from the use of white paper, which reflects more light to the eye than is necessary, and use in its place a mat surfaced paper of amber or yellow tint, or some other acceptable shade. This, I think, is the least of the two evils so long as we use black or dark symbols on white or light backgrounds.

I would like to call attention to the very valuable research work that Professor Robert M. Yerkes, of Harvard University, has conducted with reference to ascertaining the proper character and size of type that should be used in printing. Professor Yerkes, as I understand, is of the opinion that, with a little experimentation with the designs and use of type, radical changes would be the outcome.

Flaming Arc Lamps

By Theodore Stave.

Perhaps no other form of illuminant has made such rapid progress in this country during the last year as the flaming arc lamps. It is only three years ago since the first flaming arc lamps appeared in this country, and it was then generally considered as a freak and its use was at that time considered to be limited only to theatres and advertising purposes. Very little was known about the many industrial uses to which this most efficient type of arc lamp could be put. It was little known then that the principal cities in Europe had already adopted this type of lamp for the illumination of their main thoroughfares and that almost every large mill of importance had adopted them, and it is only within the last year that authorities in this country have begun to realize the enormously economic advantages of this illuminant.

As far back as 1870 successful experiments were made in Paris with a lamp which was then known as "Lamps-Soleil," and hailed as the most wonderful production in electric arc lamps ever devised. The idea, however, was abandoned on account of the high cost of carbon and of the imperfect manufacture of these carbons and was only renewed comparatively recently, when important improvements in the impregnated carbons were made. One of the principal drawbacks of impregnated carbons is the fact that after cooling they are coated with a slag which is nonconductive and will thus prevent the striking up of the arc. This trouble is more noticeable in the case of vertically aligned carbons than in the case of downwardly inclined carbons. Through very recent developments, however, the carbon makers have been able to minimize this defect to such an extent that even vertical carbons will strike up perfectly satisfactorily after cooling. It has thus been possible to develop another type of flaming arc lamps, those with vertical carbons, which, on account of the lower energy consumption, is more advisable for certain uses than the flaming arc lamp with downwardly inclined carbons; incidentally it has been possible to use larger carbons, and thus considerably increase the burning hours of these lamps. In fact, the lamp, which has only the over all dimensions of the ordinary ten-hour flaming arc lamp, with inclined carbons, can be made to last twenty-six hours. The last distribution is more favorable as the maximum candle-power is at an angle of 60 degrees against an angle of 45 degrees in the inclined carbon lamps. These recent improvements in flaming arc lamps have a very beneficial effect on the electric lighting industry, as the need has been felt more and more every day of more efficient illumination than the ordinary inclosed arc lamp, which has been almost exclusively used for the last 15 years in this country wherever large areas have been illuminated. It will not be very long until the numerous large consumers of electric light will realize that a saving of 60 to 70 per cent. can be obtained by the substitution of the old type arc lamps for this more advanced form of illumination, and thus either obtain more light at the same expenditure, or effect the material saving on their cost of lighting.

It is to be hoped that the useless expenditure of current for old, and now obsolete, lamps will be turned into more profitable channels, and that the electric lighting industry will welcome the advent of illuminants which are not only more efficient, but more suitable in cooling distribution and attraction than the old type.

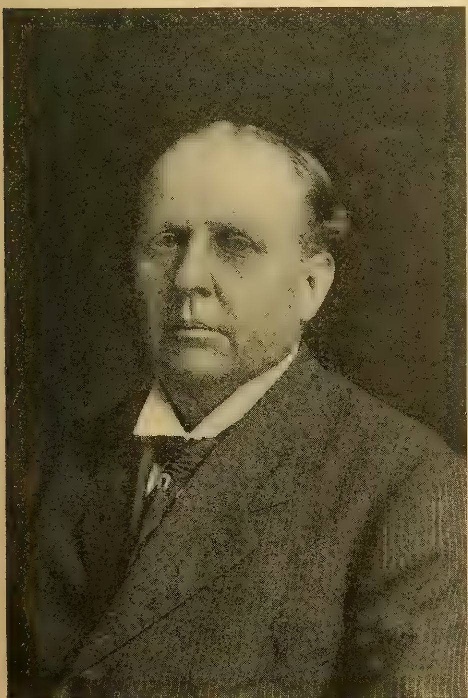
Wherever foundries or docks are concerned, the flaming arc lamps are of the greatest value on account of the fog penetrating power. It has been repeatedly demonstrated that however foggy and smoky in either foundry or mill the yellow rays of the flaming arc lamp will penetrate this murky atmosphere better than any other source of light. The result of substituting ordinary inclosed arc lamps which, as is well known, emit a considerable amount of ultra violet rays, for flaming arc lamps is so astonishing that it can hardly be believed. This is

due principally to the richness of amber rays emitted by the flaming arc lamps. It is also a well known fact that the amber rays are the least offensive to the eye, as they have the least chemical action on them. This puts the flaming arc lamps out of the field of a purely advertising purpose into that of a very much needed industrial light for foundries, mills and machine shops.

John Chamberlain Fish

Mr. John Chamberlain Fish died suddenly on Friday, April 16, at his home in Shelby, Ohio, after an illness of only four days. He is survived by his widow, three sons, his mother and one sister.

Mr. Fish was born in Sheldon, Vt., on April 14, 1864. At an early age he moved to Ohio, where he secured his education in the public schools of Akron and Shelby, and at Kenyon College, Gambier, from which he was graduated. In 1896 he organized the Shelby Electric Company, which has become too well and favorably known in the electric lighting field to need comment.



JOHN CHAMBERLAIN FISH.

In the death of Mr. Fish the cause of illuminating engineering has suffered a distinct and severe loss. From the inception of the Shelby Electric Company to the last years of his career as president of the National Electric Lamp Association, Mr. Fish was an alert and original thinker, and a progressive and inspiring worker in the field of electric lighting. It is no mere eulogistic flourish to say that the Shelby Electric Company, under Mr. Fish's immediate direction, did more to arouse that degree of public interest in the subject of lighting which culminated in the establishment of illuminating engineering as an independent branch of science than any other single agency, except the Holophane Glass Company. These two companies entered the commercial field at the same time, and, although having no business connection whatever, continued to work along the lines of public education with the same ultimate purpose always in view.

To state that it is not the light generated, but the light used that determines the efficiency of illumination, is now so simple and axiomatic a statement that it seems hard to believe that only twelve years ago this most elementary principle of illuminating engineering was almost entirely unrecognized. Simple as it may appear, the recognition of this fact was the beginning of illuminating engineering; and Mr. Fish, as manager of the Shelby Electric Company, worked unceasingly, by every legitimate means, to familiarize the public with this elementary fact.

But Mr. Fish was far more than a mere commercial enthusiast, spreading the propaganda of the more rational use of light for purely selfish, commercial ends. He was a man who looked up, as well as

ahead, and saw the sky and the sunshine as well as the dust in the road. His ultimate purpose was always progress; and he was genuinely pleased at seeing others succeed. He was possessed of a ready but always kindly wit and boundless geniality.

The broad scope of his interests and abilities is evidenced by the fact that at the time of his death he was president of four different business corporations, besides being president of the Board of Education, the Business Men's Association and the Colonial Club, and was constantly working for the social and industrial betterment of the city of Shelby.

Mr. Fish presented a distinct personality and character which endeared him to all who came to know his genuine worth. He will be sincerely mourned by every one who had the good fortune to be numbered among his friends and acquaintances.

E. L. Elliott.

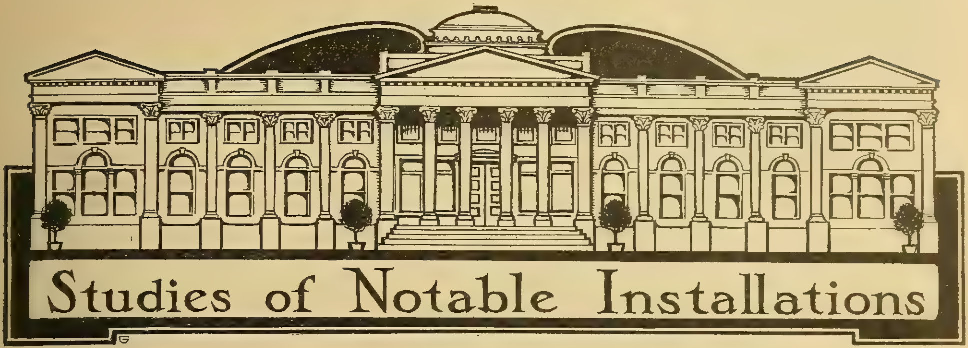
A Floating Great White Way

By F. H. Welling.

Spectacular lighting has become comparatively familiar to the people. The city or town nowadays that does not have its "Great White Way" is rightly looked upon as being decidedly behind the times. The fact that the electric light makes it possible to convert what would otherwise be a mere sleeping camp into a scene of life and festivity at night has literally been made glaringly apparent.

Accustomed as we are, however, to novelties of a daring and ingenious character, we cannot contemplate without a certain feeling of surprise the transformation of that floating city, the modern steamship, into a veritable "Great White Way." The distinction of being the first to realize this innovation belongs to the magnificent new lake steamer, "United States," which goes into commission this month. The brilliant illumination of the cabins and staterooms by electric lamps suggests a section of a business thoroughfare with its innumerable illuminated windows. In addition to this there is a festoon of red, white and blue lamps from bow to stern. In front of the funnel there is a large shield suitably formed of red, white and blue lamps, and back of this an outlined star; while between these two emblems the name of the steamer, "United States," is formed in a large sign with the letters duplicated so as to read from either side, and connected with a flasher which lights the two sides alternately. But the crowning feature is a large flag waving from its pole near the stern. It is given the appearance of actually waving by the familiar flashing effect.

THE NEW LAKE STEAMER "UNITED STATES."



Lighting the Banquet

Although possessed of abundant patriotism and fully persuaded that popular government is the best kind on earth, we are always ready to give a welcome commensurate with our patriotism to the guest representing the older governments across the water. With the exception of a few scattering small souled and narrow minded individuals, every American citizen, at least in spirit, extended a cordial welcome to Prince Louis of Battenburg, on his friendly visit to this country a couple of years ago. He was given a banquet in New York, which was spread in the best known restaurant in the western hemisphere, Delmonico's, now located at Fifth avenue and Forty-fourth street. The magnificent banquet room, with the tables

FIG. I.—DELMONICO'S.

FIG. 2.—HOTEL ASTOR.

FIG. 3.—HOFFMAN HOUSE.

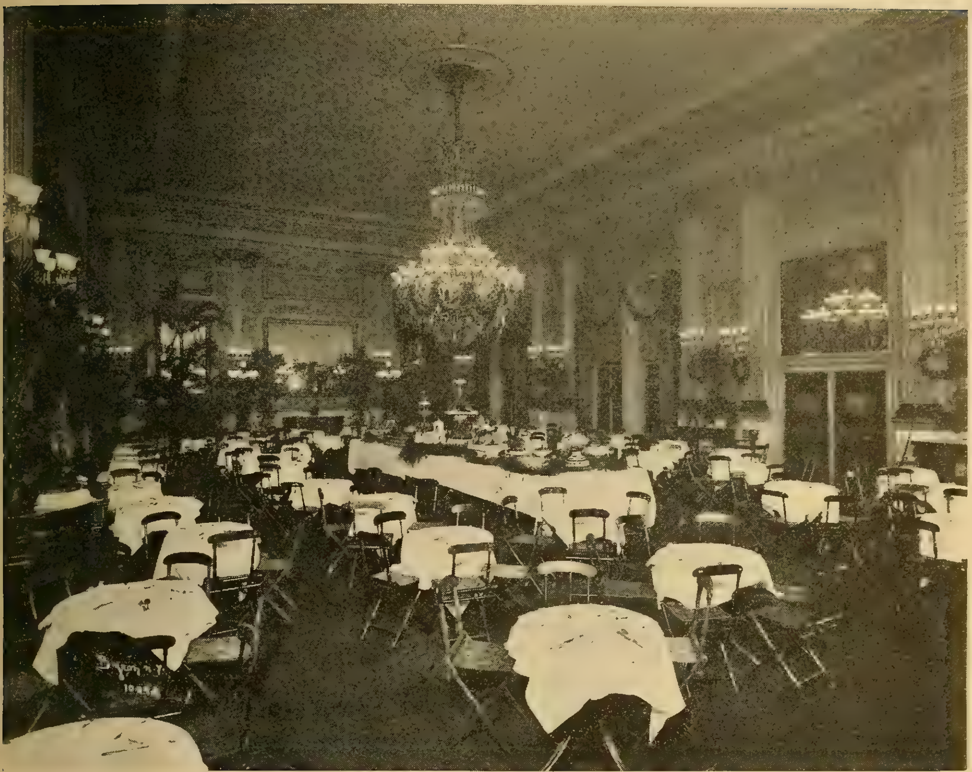


FIG. 4.—METROPOLITAN CLUB.

set for this function, is shown in Fig. 1. The room is of double height, *i. e.*, two stories, with a balcony across one end for the orchestra. The decorations are in cream color and buff, with outlining of gold. The illumination shows for itself. There are five chandeliers of crystal glass and dull gold suspended from the ceiling, with candelabra brackets on the side walls. The latter are equipped with miniature incandescents. The decoration being of the French order, the fixtures are of a character to correspond. Exquisite silver candelabra with wax candles and shades decorate each table.

At a later date we had the pleasure of welcoming a guest from diametrically the opposite side of the planet earth, and, of course, he was banqueted likewise. The principal dining room of the Hotel Astor was the scene of this festive occasion, and its appearance with the tables set ready for the distinguished guest, General Kuroki, is shown in Fig. 2. Candelabra brackets and crystal chandeliers are again in evidence, as would be expected from the character of the decorations. The use of candles on the table as one of the principal decorative features is worthy of remark.

Fig. 3 shows the first banquet given in the enlarged Hoffman House to representatives of the New York press. The familiar face of the notorious District Attorney Jerome is visible in the front. The lighting fixtures in this case are of the massive order.

Fig. 4 shows a somewhat older style of lighting fixture. The room is the main dining room of the exclusive Metropolitan Club, at Fifth avenue and Sixtieth street. The chandelier here is massive, but in a different way. It contains a large number of lamps and globes, besides imitation candles for gas flame, and an abundant decoration by means of strings of glass jewels. The individual supports of the lamps, however, are in good proportion. The candelabra brackets are of corresponding design.

Fixtures and Accessories

Hammered Metal Effect in Fixture Design

Any attempt to get away from the French designs in fixtures which have held such complete sway in this country for the past decade is to be commended; not that the designs in themselves are unworthy, or inartistic, but, having originated long before even the time of gas light, their use in connection with modern light-sources is an anachronism. Attention has frequently been called in these pages to the very general use abroad of the school of design known as Art Nouveau. Thus far this school has made comparatively little progress in this country—a fact that is probably due to the acute attack of classicisms, complicated with perioditis, which has been for some time epidemic in America. "Classic" architecture and "period" furnishing have held undisputed sway, but there are beginning to be unmistakable symptoms of an amelioration of the malady. Even architects and decorators themselves show signs of becoming surfeited with this endless rehash of old forms of art.

Art Nouveau is exactly what its name indicates—an entirely new idea in applied art. Its motives are drawn direct from nature instead of from previous "schools." It has the virtue of originality. While a few desultory examples of the application of Art Nouveau to fixtures have appeared in this country, no systematic attempt has heretofore been made to turn out a variety of the various types of fixtures along these lines. It is not surprising that the first manufacturer to practically espouse the cause of Art Nouveau in this country should be one of the newer concerns in the business. The fact that this particular house has had the courage of its convictions to the extent of investing the necessary time and money to produce a full line of such fixtures is a sufficient justification for the illustration and description of some of their pieces in these columns.

The examples shown are all intended for use with electric light. It would not be at all difficult, however, to adapt any

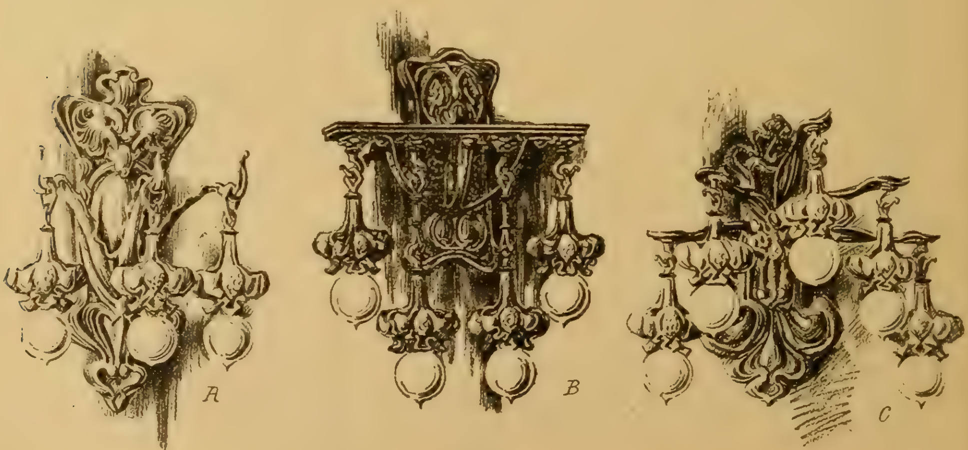


FIG. I.

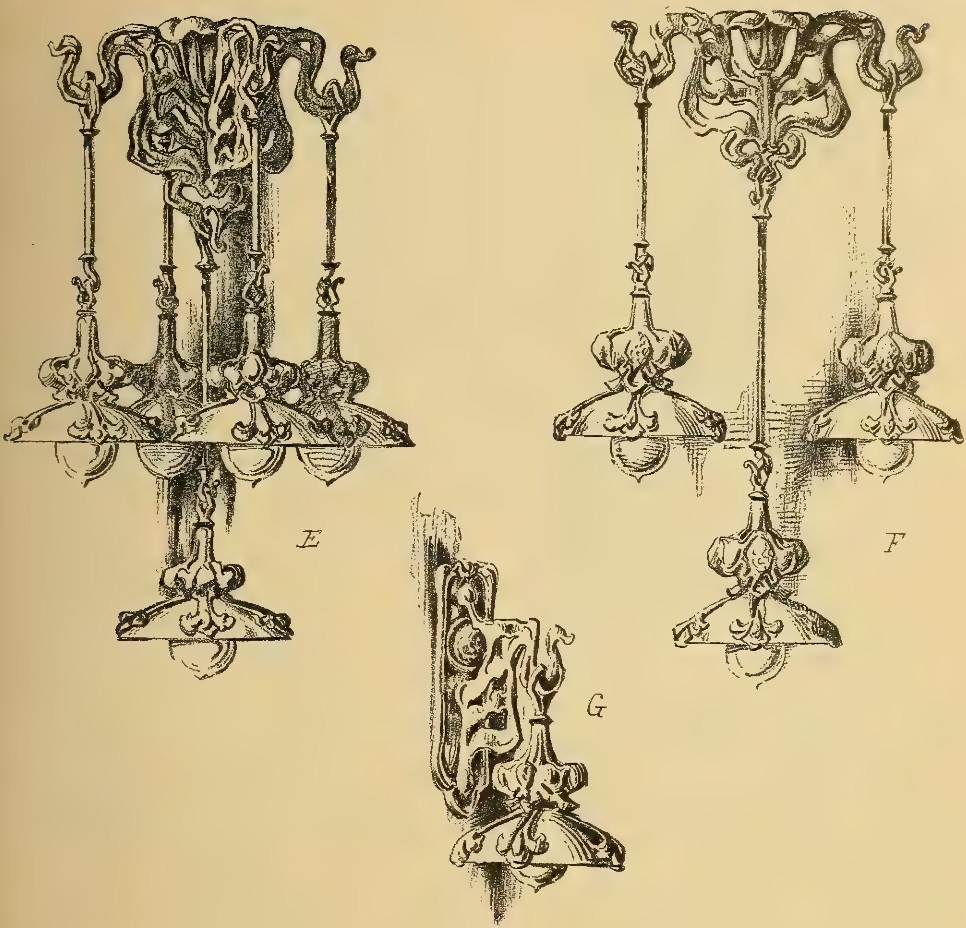


FIG. 2.

of them to the inverted gas lamp. Perhaps the most noteworthy feature is that the fixtures are professedly for the use of modern light-sources, and could not by any possibility have been used with candles or oil lamps. They are not imitations or adaptations, but distinct creations, having in view the use of the best modern means of producing light. The designs are designated as "hammered" by the manufacturer, but this more properly refers to the superficial finish or decorative effect than to the general character of the design, which, as will readily be seen, is Art Nouveau. Taking its motifs from natural forms found in plants and flowers, and the reproduction of these with as little conventionality as possible, it is wholly in keeping that they should have the appearance of having been hammered out by the manual skill of the artisan,—as if he had set up a flower or plant before him, taken a piece of metal and a hammer, and proceeded to preserve the beauty of contour and curve in more enduring material.

Fig. 1 shows brackets supporting three, four and five lamps respectively. As in all the other fixtures, the lamps are arranged to hang freely and therefore take a vertical position. The lamp and its socket are each so designed as to form a unit, hung by some natural method to a support above.

B is a particularly clever conception, affording a small shelf available for any suitable use.

Fig. 2 shows two designs of chandeliers,

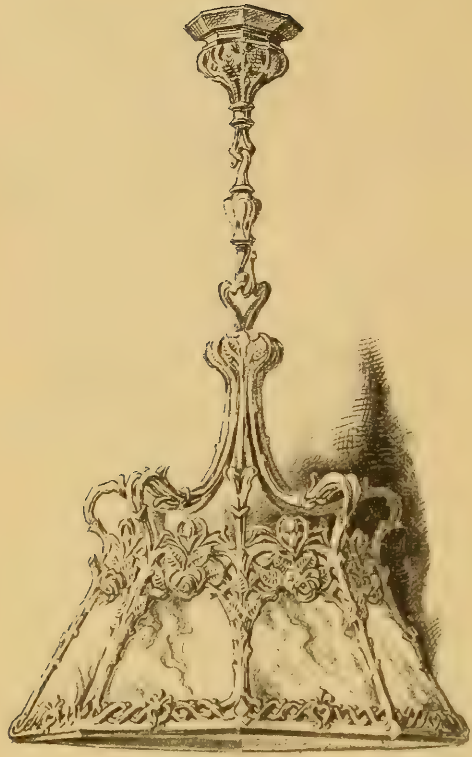


FIG. 3.

one of which has a corresponding wall bracket. The other is a very successful attempt to avoid the stiff, common-place, single central support. The ceiling plate is shown in detail.

Fig. 3 is a dome of rather elaborate workmanship, in which the proportions are exceedingly well chosen, and the general motif well sustained.

Fig. 4 shows a four-light chandelier of somewhat massive construction, but likewise of excellent proportions.

Figs. 5 and 6 are variations of this same desire to avoid the central support difficulty.

Where reflectors or shades are used it will be noted that they have been designed so as to form an integral part of the fixture, and harmonize with the general outline. Where shades are not used spherical lamps are indicated, which would naturally be used with frosted bulbs. The globes used with fixtures K and O (Figs. 5 and 6) would not perhaps satisfy the practical illuminating engineer as to efficiency, but these are evidently intended for use where decorative effect takes precedence over efficiency.

The examples shown in Fig. 6, however, while retaining a full measure of artistic effect, are capable of being made highly efficient.

Fixtures of this school of design will, of course, need to show a surface finish in harmony with the workmanship, and are therefore offered by the manufacturers in verde antique and Florentine gold.

It will, of course, be understood that fixture designs intended for unlimited reproduction must be largely made up of cast, stamped or spun parts; but that the fixtures shown may, as far as possible, represent the actual hand wrought metal, the patterns were made, wherever practicable, by actually hammering out the design.

To what extent the American public will accept "Art Nouveau" in fixture design remains to be seen. One thing is certain, fashions are bound to change; and decorative art is quite as much subject to that imitative taste comprehended by the word fashion as is dress and other habits. Whatever else may take their place, we certainly will not go on forever

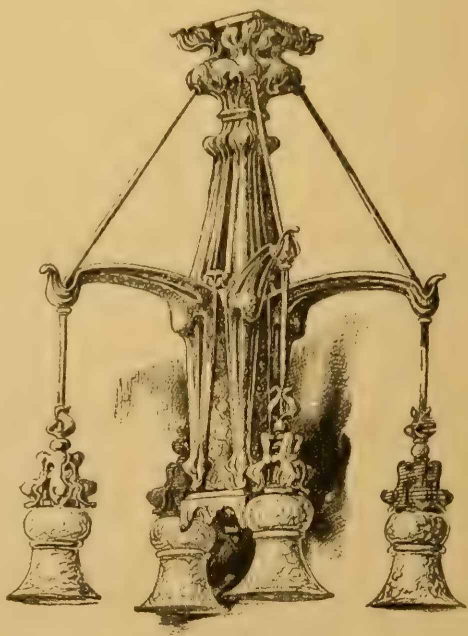


FIG. 4.

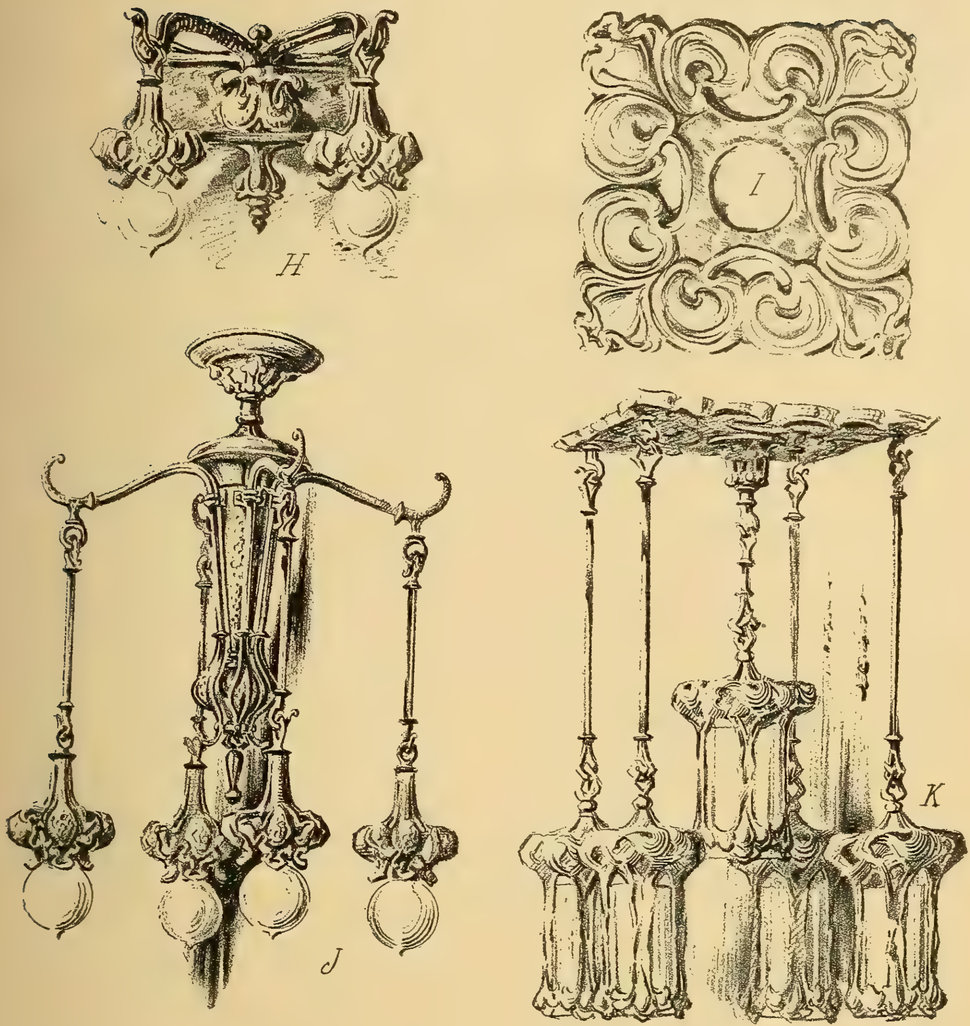


FIG. 5.

imitating the French periods of decoration and architecture. Another law of fashion is that the changes usually go by extremes; so that from the excessive elaboration and refinement of ornamentation of the French school we may expect to see a return to rigid simplicity and solidity. Unless the genius of the Art Nouveau school should acquire sufficient power to lead the people away from all traditions, which is extremely problematical, we will probably see the vigorous and substantial motives of English and Teutonic decoration and architecture come into vogue. The fixture designs shown would harmonize admirably with such schemes.

It is rather peculiar that, considering our Anglo-Saxon origin, we have been so completely dominated by French ideals. It may be asked, Why not have an American school of decoration and architecture? The same question has been asked in regard to literature and the fine arts, but never satisfactorily answered. The trouble is that we are a conglomerate race, and not yet sufficiently established to produce distinctive characteristics. The artist who would attempt to design a fixture that would be characteristically

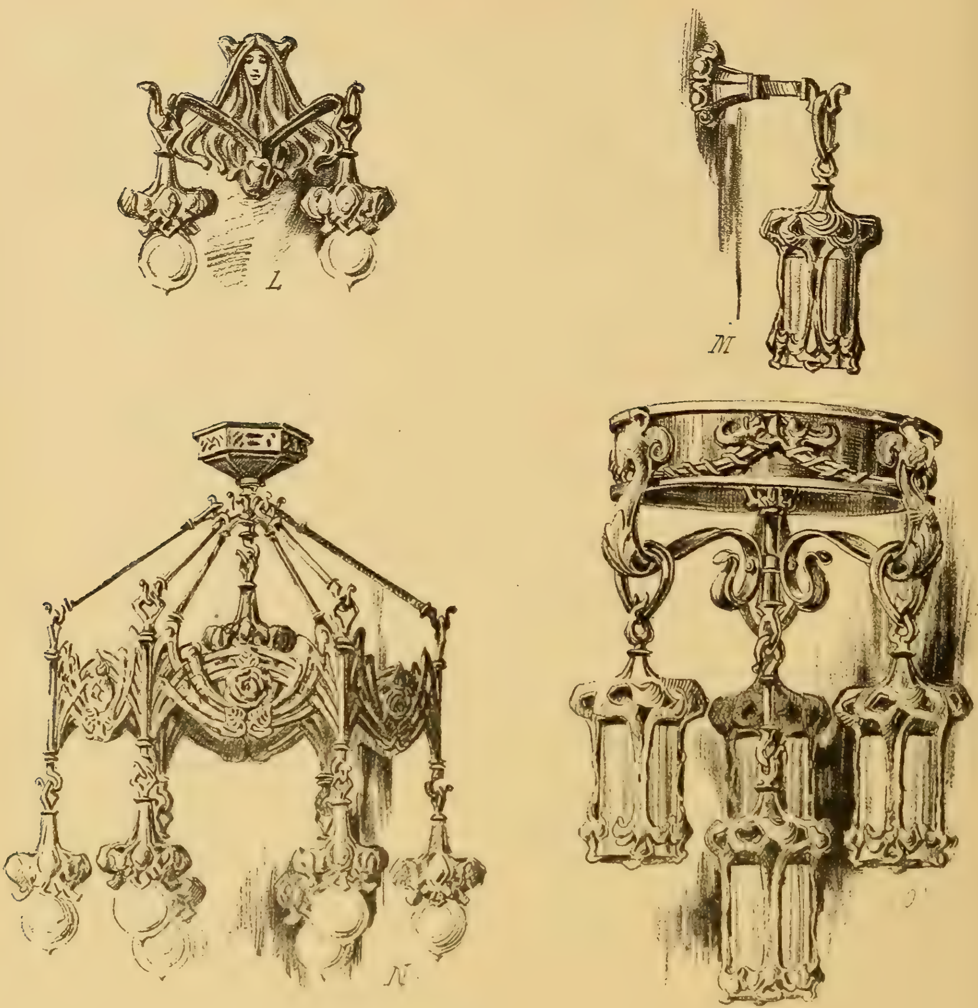


FIG. 6.

American would have to compound it from the motives of every school of art under the sun, and the result would doubtless be more curious than artistic.

There is a story of an American who besought a Chinaman to make for him a pair of trousers. This being a garment with which the Celestial was not on familiar terms, he asked for a working model, and was handed a pair that had seen much service and undergone frequent repairs. When the new trousers were delivered they were found to be an exact reproduction, including the numerous patches of the model. Our admiration and imitation of the artistic models of earlier days is of much the same order. We reproduce the sculptured frieze of the Parthenon, imitating with Chinese fidelity all the dislocations and broken parts, leaving the marble or plaster in its natural state, although it has been conclusively proven that, in the days of its pristine beauty, this really remarkable piece of sculpture was painted. If we have no ancient ruins, we can at least build new ones.

Originality in Art

By "Multipolaris."

It is probable that all art had its origin in a desire to imitate. The prehistoric remains of the earliest attempts at such imitation show simple outline sketches, usually of the human face or form, such as we see children drawing at the present time. The next step in the evolution consists of similar representations in the solid, either by molding plastic clay or by rude carvings in wood or stone. The development of the intellectual powers, and the imagination and idealism resulting therefrom, gradually lifted art above this crude imitative state until it has ceased to be essentially imitative and become creative. As the novelist or dramatist, using the universal experiences and emotions of mankind as material, constructs an ideal representation of life; and as the musician creates the new harmony from a rearrangement of simple tones, so the artist, by the delineation of man's ideal conception of nature, produces an effect that transcends the emotions produced by the contemplation of reality.

Without originality there is no art, but only handicraft. The legend of the painter who represented grapes so faithfully that the birds came to pluck them rightly enlists our admiration for his skill, but does not necessarily impress us with his artistic talent. The stone-cutter who reproduces in marble the clay model of the sculptor does not even have his name known in connection with the work, although the amount of manual skill required is really admirable. The musical composition which attempts to imitate the clatter of hoofs, the roll of thunder, or the pealing of bells is put in the same category as the plate of wax fruit, so far as art is concerned.

In the great field of applied art, the same general principle holds. The architects of the Parthenon and of St. Peter's won immortal fame, but the innumerable copyists and imitators of high and low degree have rightfully been lost in oblivion. So far as the genius of originality is concerned America in applied art has not yet been discovered. The American temple of worship, or forum, or market house, or school has not yet been built. Of more or less ingenious imitators of the good and bad that has come down to us from previous ages we have a plenty; but of what is distinctly expressive of twentieth century American civilization and its ideals we have as yet nothing.

In the lesser decorative arts we are not one whit better off. In the decoration and furnishing of our buildings, both public and private, we are merely striving to see how faithfully we can imitate the fancies of bygone times and foreign countries.

"I wish my house decorated and furnished," says the citizen.

"What period, sir?" asks the architect or decorator. If the citizen is not familiar with the particular patterns of the different periods he leaves the whole matter to the professional taste of the artisan, as he would entrust a case of sickness to his physician and swallow without question whatever prescription was ladled out to him.

Finally, to come down to that particular niche in the Pantheon of art with which illuminating engineering is concerned, the application of art to lighting fixtures is perhaps in a more archaic condition than in any other branch of artisanship. For this condition let us not place over-much blame upon the manufacturer. His is primarily a financial proposition. He is called upon to prescribe for specific cases, and may not depart too widely from the notions of his clients. Nevertheless, he cannot be held entirely blameless. While the artisan is primarily a servant of his client, he is in a position to instruct as well as to serve.

To merely copy the designs of fixtures that were developed by original genius at different times and in different countries is only a matter of mechanical skill; and to rearrange the elements of a particular school or type of decorative art requires only rudimentary creative talent; but even this is better than none at all. The number of fixtures which are more or less exact copies of French designs is surprising-

ly large. Justification for this would probably be sought in the prevailing taste for French decoration. English and Colonial patterns are also frequently reproduced.

Undoubtedly a faithful copy of any of the great masters of painting has its value, and a spirited discussion might well be carried on as to the choice between a good copy of a good work of art and a poor or mediocre original. The strongest claim of the latter would be that progress lies only along the line of originality, and that to attempt and partially fail is a step toward final success. Even the restriction of following the general motif of a particular school or period is not necessarily prohibitive of real creative art. "The letter killeth, but the spirit giveth life." It is the slavish adherence to the letter of form and construction that kills true art; to work in the spirit of the artists of any period is to breathe the breath of life into the results. What sort of a fixture would Le Brun have designed had he been possessed of the electric light, or the inverted gas burner? To answer that question by physical results requires a degree of imagination and originality that is the very essence of true art. To reconstruct a candlestick and place an electric lamp in it is the act of a child that ties a handkerchief around a clothespin and fancies it a doll.

There is no little protest being heard in professional, as well as popular, circles against the imitative in architecture and decorative art. The time is surely coming when the new heaven and the new earth which modern science has created will find expression in the artistic productions of both pure and applied art.

A Picturesque Town

The above illustration is reproduced from a postal card kindly contributed by a subscriber. Besides the picture of Arcadian simplicity which it presents, it is interesting as showing the means used to light the public square, namely, by gas lanterns supported on decorative iron brackets. It is worth remarking that this bracket is an excellent piece of design and workmanship, although attached to a building of very modest pretensions and in a small town. Under corresponding conditions in this country we would probably find a single electric lamp hanging to a gas pipe goose neck screwed on to a wobbly wooden pole.

Theory and Technology

Plain Talks on Illuminating Engineering

BY E. L. ELLIOTT.

XXI. Exterior Lighting: The Use of Globes and Reflectors.

Aside from the waste of the light that is given out above the horizontal or 20 degrees below, there is also the further waste of light which is thrown sideways. Take for example a street 60 ft. wide, with lamps placed over the middle of the pavement 100 ft. apart; consider the circle of light given out by each lamp, Fig. 1; a calculation of the surface of this circle, and the surface of the roadway within the circle—a mathematical operation which we need not repeat here—will show that the street surface occupies 38 per cent. of the surface covered by the light.

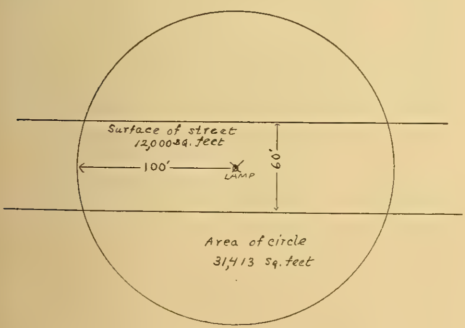


FIG. 1.

How can all this waste of light be avoided? That is a question which has attracted the attention for more than a century of those interested in street lighting. The idea of using a reflector to intercept the upward rays and redirect them on to the pavement is certainly as old as the public use of gas, but the problem has not been satisfactorily solved up to the present time. The possibility of making globes having a lens-like formation, so as to concentrate the rays from the light-source in a given direction, was also conceived many years ago. So long as gas flames were the only means available, neither of these methods were at all practical. In no case was street lighting any more than a rather inferior quality of beacon lighting; the thing to be seen was not the street, but the light itself, and there was nothing to be gained by covering this up with a globe, or shading it with a reflector. Modern radiants, however, have entirely changed conditions, and the question of the best reflector or globe to use with each particular radiant is one of importance.

This subject of reflection and refraction of light has been the source of continual discussion since illuminating engineering became established, and we regret to admit that there has been much "darkening of counsel by words without knowledge." The reflector is an uncommonly seductive thing to juggle with, and even those possessing a considerable degree of technical knowledge have often been deceived

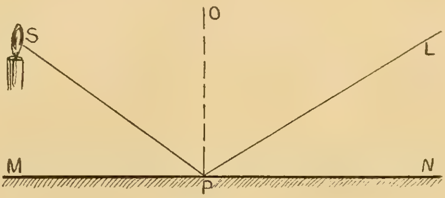


FIG. 2.

thereby. The principles involved are simple and easy enough to comprehend and remember when stripped of superfluous technicalities. It is absolutely necessary to this end that the single law of reflection be clearly comprehended, and the apparent modifications of this law in actual practice be understood.

The single law referred to is the familiar statement: *The angle of incidence equals the angle of reflection.* The meaning of this is, that a single ray of light, SP, striking a reflecting surface at P, will be reflected from that surface in such a direction, PL, that the angles SPO and OPL are equal, the line OP being perpendicular to the reflecting surface. This is the theoretical case, and applies only to the imaginary condition of a single ray of light striking an infinitely small, flat surface. In practice we deal, not with single rays of light, but with beams of light, *i. e.*, light filling a measurable space, and not with infinitely small surfaces; but with measurably large surfaces. These conditions produce apparently widely differing results, which may be divided into two pretty distinct classes. Thus, if the reflecting surface is flat, or of any other regular formation, such as a part of a sphere, or any definite curve, and smooth, all the rays of light after reflection will follow determinate paths. This is the case with the ordinary mirror, the surface of still water, and, in general, of all polished surfaces. Such reflection is called regular, or sometimes specular (from *speculum*, a mirror). It is by this kind of reflection that we see images of objects.

If, however, the reflecting surface is rough, such as that of white paper or porcelain, the rays of light, instead of being reflected in definite directions, are scattered in every possible direction from every point of the surface; that is, every point becomes practically a new source of

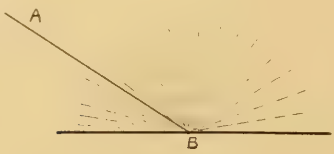


FIG. 3.

light sending out rays in all directions (see Fig. 3). This is irregular, or diffuse, reflection, and is that which enables us to see non-luminous objects. Both kinds of reflection may take place from the same surface; for example, from a polished white surface. In this case there is regular reflection from the polished, and diffuse reflection from the white, or under surface.

Let us now see these conditions apply to the problem of designing street reflectors for street lighting.

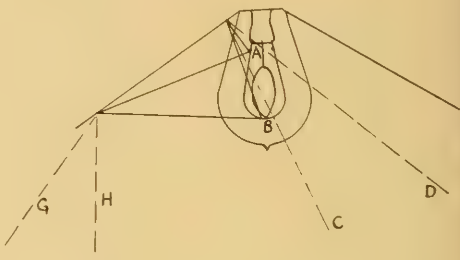


FIG. 4.

Let us assume that we have a radiant of any kind, such as an electric lamp or mantle gas burner. From what was said in the preceding article, the reflector cannot extend below 10 degrees from the horizontal; otherwise it will obstruct rays which will be useful if allowed to proceed in their regular course. Let us see first what can be done with a regular, or mirror, reflector. Take the simplest shape, namely a cone, as in Fig. 4. We must bear in mind that we have not the theoretical "point source" of light, but a luminous surface of greater or less extent—as from A to B. Curiously enough it is only within very recent years that such calculations as were made in regard to reflecting apparatus were all based upon point sources of light, and hence, when used under actual conditions, were so far wide of the mark as to render all the calculations practically useless.

Drawing rays from the top and bottom of the radiant, AB, to the upper part of the reflector, and tracing their reflected directions according to the law, we find that the light reflected from this portion will fall within the space CD. Drawing, in a similar manner, rays to the lower

part of the reflector, EF, and tracing their paths after reflection, we find that they will fall within the space GH. An examination of these results brings out the very important point that a reflector of this type concentrates the reflected light; *i. e.,* adds it to the illumination within a comparatively small circle directly underneath the source. Since the illumination on this surface in street lighting is always greater than that at any other point, and usually more than sufficient, the inutility of such reflectors for the purpose of producing a more uniform illumination is at once apparent.

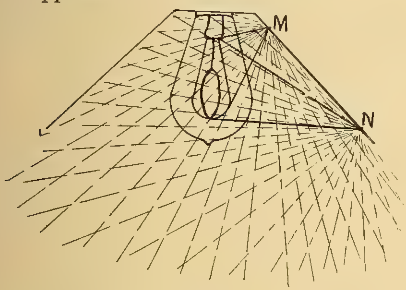


FIG. 5.

Now let us assume that our reflector is a perfectly matt white surface, Fig. 5. No matter in what direction the rays strike it, every point will send out rays in every direction. If we consider only the two points, M and N, we see that some of the rays will be sent out at wider angles, *i. e.,* in a larger circle below, than when the regular reflector is used; also that a considerable part of the reflected light will strike the opposite side of the reflector, where it will be again reflected. As there is always absorption at every reflection, additional loss from multiple reflections may be considerable in such cases.

A very interesting and important fact in regard to diffuse reflectors is that the distribution of the reflected light is independent of the contour or shape of the reflector—assuming, of course, that the reflecting surface is perfectly "matt," a supposition which is never quite true. There is always more or less polish to the white surfaces used for reflectors, which produce a certain amount of regular reflection; but the proportion is always comparatively small. When diffuse or white surface reflectors are used, therefore, the shape may be determined wholly by other conditions, such as protection from the weather, convenience of manipulation, etc.

Another fact which follows from this same principle is that all methods of corrugating or fluting the surfaces of diffuse reflectors, either radially or concentrically, is entirely useless, so far as the distribution of light is concerned. In fact, a strict application of the principle shows that corrugations or flutings produce a certain amount of absorption that would not otherwise exist, and are therefore worse than useless. The amount, however, is really so small as to be of little practical moment, and where flutings or corrugations add to the mechanical strength, or are otherwise useful, they may be used.

Another important consideration is the amount of light which the reflector intercepts. Examine the cases shown in Fig. 6. The conical reflector placed in the lower position will intercept all of the light given out above the horizontal, or level of the source. If placed in the upper position it intercepts only the light given out above 20 degrees above the horizontal. In this connection the rapidly

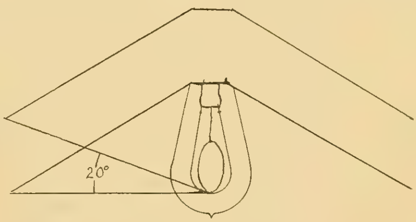


FIG. 6.

diminishing quantity of light as we go from the horizontal toward the vertical must be carefully considered. (See Plain Talk, November, 1908, issue.) Thus, the light given out in this angle of 20 degrees is 40 per cent. of all the light in the upper hemisphere; in other words, the reflector in the upper position intercepts only 60 per cent. as much light as when used in the lower position. This is the weakness of all reflectors placed above the radiant; they do not intercept a sufficient quantity of light to be of any great value.

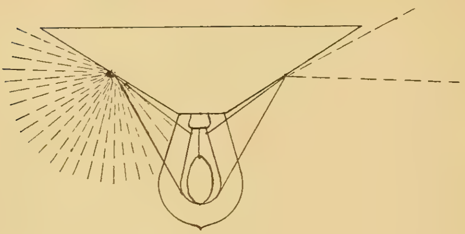


FIG. 7.

There is a type of reflector which may be called the inverted cone, *i. e.,* in which the rays strike the outside rather than the inside of the cone, as in Fig. 7. These have theoretically the advantage that if they have a regular or mirror surface they can be formed so as to throw the reflected light out at wide angles, as shown in the illustration referred to; but they intercept only a small part of total flux of light, and if made of a diffuse reflecting surface, are practically useless, since they throw a considerable portion of what they do reflect upward, as shown on the left side of Fig. 7.

After taking into account all practical, as well as theoretical, conditions, the most feasible form of opaque reflector, especially if a diffusing surface is used, is either a flat disc placed as nearly as possible on a level with the radiant, or a cone having an angle of at least 80 degrees. This may be made sufficiently large to give the lamp ample protection from wind, rain and snow.

(*To Be Continued.*)

Concerning the Flux of Light Method

By J. S. Codman and T. W. Rolph.

In the February edition of the Illuminating Engineer, Mr. Alfred A. Wohlauer has shown, in a very interesting article, a simple method of reading off from the photometric curve of a light source, the flux of light through a zone bounded by any two angles made with the vertical, as, for example, 10 degrees and 20 degrees. He proves that if we take a not too large sector of our diagram the flux of light through the zone of the sphere corresponding to this sector will be directly proportional to the distance from the vertical, of the intersection of the candle power curve with the vector bisecting the sector. For example, the flux through the zone between 40 degrees and 50 degrees will be very closely proportional to the distance from the vertical, of the intersection of the candle power curve with the vector of 45 degrees. Finally, Mr. Wohlauer shows that by superimposing on the polar diagram sheet a system of horizontal and vertical lines drawn to a certain scale corresponding to the candle power, it is possible to read off with great ease the flux in lumens for any particular zone, and he has embodied this idea in his "Fluxolite" paper.

It is possible, however, to use to great advantage the above method of reading flux directly from a photometric curve even when we use ordinary polar diagrams without "Fluxolite" lines. A scale can easily be made corresponding to the candle power scale used on the diagram, and this scale can be made to read directly in lumens. If a person has occasion to investigate a number of photometric curves, all of which have the same candle power scale or some simple multiple of it, this method is very convenient, as the same scale of lumens can be used with all the curves.

It would be far more convenient, however, if instead of having to make a special scale of lumens it were possible to use an ordinary scale of inches and fractions. This would be possible if the publishers of the polar diagram sheets would make the sheets to such a scale that there would be a convenient number of lumens to the inch.

In order to ascertain what would be the most convenient scale for candle power and lumens, we have first to find the necessary relation between these two scales. This can be found from the following formula derived from those given by Mr. Wohlauer:

$$\frac{\text{Lumens per in.}}{\text{C. P. per in.}} = \frac{2\pi\left[\cos\theta - \cos(\theta+\alpha)\right]}{\sin\left(\theta+\frac{\alpha}{2}\right)}$$

In this formula θ and $\theta + \alpha$ are the angles of light vector with the vertical. If now the angle α is made constant in this formula, it follows from Mr. Wohlauer's demonstrations that the above ratio is a constant, that is, it is independent of the value of θ. In other words, there is a definite ratio between lumens per inch and candle power per inch for each value of α.

The smaller the value of α chosen, the greater will be the accuracy, but for practical work ten degrees will give sufficiently accurate results. With α equal to ten, the ratio of lumens per inch to candle power per inch is found to be 1.095. If, therefore, we make 1.095 inches an exact multiple of the candle power scale division, we have a diagram from which the lumens can be read directly by means of an inch scale. For example, if we make ten scale divisions equal to 1.095 inches, then the lumens per inch will be numerically equal to the candle power corresponding to ten scale divisions. This scale would not be an inconvenient one. The scale division would be 0.1095 inch, which is somewhat larger than that most commonly used, which appears to be 0.0775 inch.

For smaller diagrams, a convenient scale would be 20 scale divisions equal to 1.095 inches, in which case the lumens per inch would be numerically equal to the candle power corresponding to 20 scale divisions. This is almost exactly the scale used by the Illuminating Engineering Publishing Company for the diagrams which it publishes under the copyright of Mr. Macbeth. In these diagrams 20 scale divisions equal 1.1 inches, which differs from 1.095 by less than one-half of 1 per cent.; and since also these diagrams are divided into 5-degree angles, it is possible to read off directly the lumens of 10-degree zones by means of an inch scale. It would be interesting to know if the choice of this scale by Mr. Macbeth was merely a coincidence.

If, in order to get greater accuracy, we wish to use 5-degree instead of 10-degree zones, the ratio of lumens per inch to candle power per inch is 0.548. It should be noted, however, that twice this figure is 1.096, which is practically the same as the ratio with 10-degree zones. It follows that we can use the same diagrams for 10 or 5 degree zones, and measure flux in both cases with a scale of inches, simply bearing in mind that the lumens per inch for 5-degree zones will be one-half the number for 10-degree zones.

Similarly, with the same diagrams and with an inch scale, it is also possible to read off the lumens directly for zones of some other sizes, without much sacrifice of accuracy, by simply multiplying the lumens per inch for 10-degree zones by one-tenth of the new zone angle. The degree of accuracy under these circumstances is shown by the following table, in which are shown the correct ratios of lumens per inch to candle power per inch for zones of different sizes, together with these ratios divided by one-tenth of the zone angle chosen:

α	Ratio.	Ratio $\div \frac{\alpha}{10}$
5°	0.548	1.096
10°	1.095	1.095
15°	1.64	1.093
30°	3.25	1.083
45°	4.81	1.069
90°	8.89	0.988

It will be seen from the last column that the same lumen scale can be used for zones up to at least 15 degrees, and with larger zones than 15 degrees the results would usually not be sufficiently accurate even if the strictly correct lumen scale were used.

In closing, the writers would like to express their high appreciation of the work done by Mr. Wohlauer.

Chemistry and Hygiene

The sciences of chemistry and bacteriology have put hygiene upon an entirely new basis. Our old ideas as to the causes of "what ails us" have got to be thoroughly revised. The science of bacteriology has been even more far reaching in its solution of the many problems concerning health and disease than the science of chemistry. For example, chemical impurities in drinking water are in themselves practically harmless. The chemical analyses which were almost implicitly relied upon twenty-five years ago as a means of distinguishing between safe and dangerous waters have been found to be of no positive value, but at the best only serve to indicate the possible presence of really dangerous impurities in the shape of micro-organisms. One city may drink the diluted sewage of another city, as is done in many actual cases, with impunity, so long as the city furnishing the sewage is not infected with certain contagious diseases, notably typhoid; while on the other hand, apparently pure and sparkling water from a mountain stream may be almost as deadly as though charged with mineral poisons.

The presence of sewage contamination in water can be readily detected by chemical tests, but the only valuable knowledge which this gives is the mere inference that typhoid germs may be present, since it is well known that they are distributed in this way. The same general facts hold in regard to the air we breathe. Thus, the amount of carbon-dioxide, or carbonic acid, as it is more commonly called, present in the air may be readily determined by the chemists; but so far as this particular chemical in itself is concerned its only effect upon the air is to dilute it; it is not actively poisonous in itself. This same carbon-dioxide when absorbed by water gives the sparkle and pleasing taste to which soda water and all "sparkling" drinks owe their popularity.

Carbon-dioxide is always present in the air, and arises from two principal sources: combustion, and the action of the lungs upon air that has been breathed by man and the lower animals. The amount of carbon-dioxide, considering it as a chemical without the presence of any other substance, which can exist in the air without being injurious or appreciable is comparatively large; but when the carbon-dioxide is the result of exhaled breath there is always present with it other matters thrown off by the lungs, and just as the presence of sewage in water indicates the possibility of accompanying dangerous germs, so the presence of carbon-dioxide in the air, when known to be due to exhalations, shows the possibility of other dangerous gases or germs being present. The subject derives its importance, as well as its relation to illuminating engineering, from the fact that all gas burners of necessity produce carbon-dioxide. It is evident that carbon-dioxide produced in this way must be wholly devoid of any dangerous organic matter, and, on the other hand, the heat of the flame will destroy all living organisms that come in contact with it. The subject of vitiation of the air by gas burners has, therefore, lost its importance in view of modern hygiene.

Another product of the combustion of

illuminating gas which has given rise to recent investigation and discussion is sulphur-dioxide. This is the product of burning sulphur, or sulphur compounds, in the air. Sulphur-dioxide is gas in its natural state, and has the properties of an acid, hence is known by the chemist also as sulphurous acid. In sufficient quantities it has an irritating effect upon the membranes of the throat and nose, familiar to all who have inhaled fumes of an old-fashioned sulphur match. It blackens silver, brass, nickel and copper, and readily unites with alkalines. The lime in wall plaster, being a strong alkali, very readily absorbs the gas by combination. In a sufficiently concentrated state sulphur-dioxide is fatal to animal and insect life, and in a much more diluted form is a germicide.

As all coal contains some sulphur, it follows that coal gas of necessity contains more or less sulphur compounds. When illuminating gas was first proposed for commercial use it was said that it could never be used for interior lighting on account of the sulphurous fumes given off; but the discovery of practical means of eliminating the sulphur compounds in the gas removed this obstacle. For commercial purposes, however, it is impracticable to eliminate the last traces of sulphur; hence the legal regulations that have generally prevailed in regard to the amount of sulphur allowable.

The question has lately come up in Massachusetts as to what the limit should be, and an elaborate investigation of the matter has been made by the associated gas companies. There is a common opinion that anything which is injurious to the health in large quantities is proportionately injurious in any quantity; but such is not necessarily the case. For example, there are any number of elements in common foodstuffs which, if taken in a concentrated form, would be either deleterious or active poisons, while in the minute quantities as they exist in natural products they are beneficial. It is hardly likely that sulphur-dioxide is beneficial in any quantity, although it might possibly have some effect upon dangerous bacteria. There is some point, however, below which the quantity present becomes entirely innocuous. The question is, What is this point? It is no easy matter to decide; perhaps the only solution is to actually "try it on the dog," so to speak, as Dr. Wiley has been doing in his investigations of food preservatives; i. e., to allow human beings to breathe air containing various quantities of the gas for different periods of time, and carefully note the effects.

The law in Massachusetts has limited the amount of sulphur which may exist in illuminating gas to 20 grains per 100 cubic feet. Why this particular limit has been set does not appear, and the gas companies are endeavoring to establish a higher limit as being safe. This effort is not only legitimate, but will be a distinct service in the advancement of science. Where knowledge can be obtained by experimental means, guessing certainly has no license to exist. Instead of putting this movement down at once as a scheme of the corporations to impose upon the public it should be given an unbiased and thorough trial. The foundation of natural science is experiment, and the foundation of modern civilization is natural science. Let us by all means, then, have the subject sifted in the most thorough manner, and let the results benefit whoever they will.

Relative Color Values of Artificial Light Sources

A great deal has been heard of late regarding the daylight effect of illumination from the newer electric lamps, and this quality has been used to the utmost in advancing their sale. One of the most curious phases of the general apathy heretofore shown by the gas interests toward illuminating engineering is their total neglect to set forth the actual facts in regard to the color quality of modern gas light. It is true that in the earlier days of the incandescent gas mantle it produced a light which was distinctly greenish in color, particularly after it had been sometime in use; but this defect has long since been removed. The better quality of mantles in common use long before the advent of the metallic filament lamp produced a light which is at least as near an approach to daylight in color as the best of these new electric lamps, or the Nernst

lamp, and yet practically nothing has ever been done by the gas interests to make this fact known.

The whiter quality of the light of the new electric lamps, on the other hand, has been so thoroughly exploited that it will now be difficult to persuade the public that there is any other form of light "just as good." Buyers are always suspicious of the "just as good" article, and generally rightly so; it savors too much of the "me too" brand of personal character. With both men and things it is those that stand on their own merits, rather than those that trail along in the wake of others' success, that compel admiration and respect.

The gas lighting interests have never essayed to boldly meet the electric light on the grounds of quality. While the electric light has been loudly singing the praises of its sun-like whiteness, gas light has been content to twitter with bird-like repetition, "cheap, cheap, cheap." Every day that the gas interests now lose in taking advantage of illuminating engineering—for quality of illumination is no less important a consideration with the illuminating engineer than quantity—they are making it so much the harder to overtake their competitors, to say nothing of getting ahead in the race.

Lux, or Foot-Candles?

The honor of having outlined a complete and scientific series of photometric units belongs to Professor André Blondel, who in 1893 published his essay on this important subject. Owing chiefly to the lack of uniformity in standard light-sources in the various countries, this admirable system has come into very little use. The lumen is now fairly well established in this country, but has a different value from the one proposed by Blondel. We have Anglicized the term, so to speak—*i. e.,* have reduced it to the English system of measurements—so that its meaning in this country is the flux of light required to illuminate a surface of one square foot with an intensity of one foot-candle.

The term foot-candle has been used rather more commonly than the term lumen, owing to its more self-explanatory character. A few years ago it was often used the other way around—*i. e.,* candle foot—which gave trouble in forming multiples, candle-feet being a manifestly undesirable expression. Professor Blondel suggested the very neat word "lux" for the unit of intensity of illumination. Naturally he used the metric unit of length, the meter; and since the Hefner lamp has come to be quite generally used as a primary standard of light the combination, Hefner-meter, has been used as the intensity signified by the term lux. Whether the English unit of length, the foot, and the candle power standard of light will be finally adopted in giving the value to the lux remains to be seen. Usage has not yet been sufficient to establish a value, and it will undoubtedly remain for the various international authorities now having the whole subject under advisement to arrive at a conclusion. If the meter is decided upon, however, it is sufficient to assume that the word "lux" will remain useless in this country for a long time to come, and the term foot-candle continue in its present position. It is next to impossible to overthrow usage, in this country at least, as witness the efforts to introduce the metric system.

Let us hope that the authorities will decide, so far as possible, in accordance with present custom.

On Fooling All the People All the Time

There is no symptom which the practical politician views with greater apprehension in the feverish period immediately preceding an election than over-confidence. Under this condition the unexpected has frequently happened, and the apparently weaker party has won the election. The gas interests, so far as light is concerned, are now suffering from past sins of this kind. Signs are not wanting, however, that the tide may turn, and leave the electric lighting interests to rub their eyes and find out what it was that struck them. With the introduction of new and improved electric lamps and the use of light-saving accessories, the electric lamp manufacturers have descended to all kinds of jugglery in order to either keep the people in ignorance or actually mislead them as to the real performance of the different units. Rating

by horizontal candle power, while unscientific, had some limits to its manipulation. The filament of the incandescent electric lamp can only be lengthened out to a certain extent at the most; and in the case of arc lamps no pretense was made of an actual connection between candle power and light intensity. As a result of all this the rating of all kinds of light-sources at the present time is in utter chaos.

The rating of a light-source by the lumens produced would solve the whole problem.

But instead of working toward this end it seems that the electric lamp manufacturers are drifting still further away; while the mantle burner people, it is reported, are about to accept this method of rating. The electric people have fooled the people so long in the matter of lamp rating that they have become over-confident, and this is the opportunity for the gas lamp people to win a very important strategic point. By rating their own light-sources in lumens, and by a judicious publicity campaign to explain this method, they will put the electric lamp manufacturers in the position of following on in the rear.

Will the gas people be equal to the occasion?

Selling Light

We have persistently maintained that light should be sold as such, its money value to be reckoned upon some sort of photometric measurement rather than upon the illuminant used to produce it. The unexpectedly rapid introduction of the new electric lamps, both arc and incandescent, seems destined to bring about this desired change. We have previously mentioned the move made by the electric lighting company in Hartford along these lines, and we now have advice of a similar action on the part of the central station in Richmond, Ky. In the latter case, however, the matter was more definitely determined by being embodied in a franchise granted by the City Council. The exact provision is as follows:

> The purchaser of this franchise or privilege, or any successor, transferree, or assignee of such purchaser shall not charge for electricity for any purpose a rate which will make the cost of electric light to any citizen of Richmond using more than $1 worth of electricity, per month, with the most efficient incandescent lamps, more than 3½ cents per 100 cp. per hour.

While this is a distinct step toward the desired end, it is exceedingly regrettable that the provision of the franchise is made in such loose terms. One would suppose that, after all the trouble that has been occasioned by the old "2000 candle power" rating of arc lamps, more care would be taken in the use of the term "candle power" in legal phraseology. There is the best possible ground for controversy over the meaning of the term "candle power" as used in this franchise. The customer would have most excellent grounds for claiming spherical candle power, which is really the only meaning of the term which would be definite and applicable to all kinds of light-sources. It is probable, on the other hand, that the lighting company had in mind the old horizontal rating of lamps when it had the word candle power used. Between these two meanings there is a difference of from 20 to 25 per cent. with reference to the tungsten lamp, and a much greater difference in reference to arc lamps.

The central stations now find themselves in difficulties on account of the introduction of the higher efficiency lamps, which would have been entirely obviated had they based their charges on the light produced rather than current consumed. It seems incomprehensible that people who had the responsibility of providing dividends on electrical enterprises should not have foreseen that improved lamps were bound to come sooner or later. It is, of course, inevitable that the producers of electric light must continue to have a profit on their business, and that a portion of the advantages of the new lamps must accrue to them as well as to the consumer. The only safe course now is to come squarely out for the sale of light on a basis that can be understood by the average user. *The word candle power,* UNQUALIFIEDLY, *must never be used for this purpose.* The word lumen is by all odds the better term, but if candle power is to be used at all, spherical candle power should in every case be stated. It never pays, in the long run, to play fast and loose with the public.

Notes and Comments

Gas Lighting Assists in Ventilation and Improves the Condition of the Air, According to the "Scientific American"

QUOTES PROFESSOR VIVIAN LEWES AS AN AUTHORITY FOR THIS STATEMENT.

Now that competition between gas and electric light has become somewhat keener in this country, the old question of vitiation of the air by gas burners seems to be bobbing up again. The last comprehensive discussion of this well-worn subject was a lecture by Professor Lewes, delivered before one of the scientific societies of England something more than a year ago. The arguments presented are used in the answer to a correspondent in *The Scientific American:*

(12057) C. B. B. asks: I have a problem to submit, the solution of which will confer a great favor upon the writer. There are two large public halls with practically no ventilation; one is illuminated by gas, the other with electricity. Both rooms are occupied by the same number of people. In which room, the former or latter mentioned, is the air purest? Does not the gas have a tendency to purify the oxygen by consuming a large percentage of the impure air or hydrogen? A. Although not at all for the reasons you give, it has been sufficiently proven that under equal conditions of ventilation (whether good or bad) the air at breathing level in any room illuminated by gas will, after several hours' occupation by a number of persons, be more healthful than if the same room was electrically lighted. The products of combustion of a gas flame in air are largely identical chemically and nearly identical physically with those of exhalation from human lungs, and as the least quantity of gas consumed by a single burner (say 4 cu. ft. of gas per hour for an atmospheric incandescent mantle) produces 2 cu. ft. of carbon dioxide per hour, while an average man breathes out only 0.6 cu. ft. per hour, one gas burner vitiates the air of a room more than do three persons. As incandescent electric lamps not merely add nothing to the impurities of the atmosphere, but withdraw no oxygen from it, it has been assumed not unnaturally that it must be the most hygienic form of illumination to employ; but in the years which have elapsed since electricity was first used for lighting purposes, experience has increasingly proved the contrary. The burning of gas does not in any way purify the air or consume any irrespirable constituents—quite the contrary; but because the heating effect of gas in proportion to its lighting effect is so much higher than that of electricity, the carbon dioxide, otherwise much heavier than air, is heated sufficiently to rush to the ceiling of a room, where its descent upon cooling is prevented by diffusion. The explanation involves chemical, physical and physiological considerations and cannot be at all completely given here, but you will find it admirably discussed in an article by Prof. Vivian Lewes, a high authority on this subject, in our *Supplement,* Nos. 1661 and 1662, which we shall be glad to send for 10 cents each, postage paid.

Boston Makes Contract for Street Lighting, with a String to It

EDISON COMPANY GETS A FIVE YEAR CONTRACT UNDER TERMS FAVORABLE TO THE CITY. MORE TIME GIVEN THE GAS COMPANY TO SHOW WHAT IT CAN DO.

Letting of the contract for lighting the streets of Boston is of more than ordinary interest to illuminating engineers, by reason of the fact that both the gas and electric companies have been presenting their claims on an illuminating engineering basis. The Electric Company has a number of competent consulting illuminating engineers, mention of which we have previously made in these columns, and the Gas Company has been experimenting along illuminating engineering lines. The upshot of the matter is thus reported in *The Transcript:*

Mayor Hibbard has signed a provisional contract with the Edison Electric Illuminating Company for lighting the streets for a period of five years. Under the terms of the contract the city will save $55,000 annually in electric street lighting over the contract with the same company which expired some months ago. Under the old contract the city paid $435,000 a year.

The contract which the Mayor signed provides among other things that the Mayor may call upon a Board of Arbitration consisting of the heads of the scientific departments of Harvard and the Institute of Technology and a third member selected by the

scientific department heads of the two institutions to decide whether any changes in the contract price should be made.

Before signing the contract the Mayor made his acceptance provisional for six months to give the gas companies an opportunity of further demonstrating their scheme of street lighting and submitting other bids.

Philadelphia to Be Lighted Up to Guide Airships as Well as Surface Traffic

THE PRESS PROPOSES PLAN BY WHICH THE CITY WILL BE MARKED BY THE SIGN OF THE CROSS FOR AERIAL NAVIGATORS.

The *Philadelphia Press,* which has been the leader in the movement for better street lighting in the Quaker City, proposes to nail the City Hall to the cross, if not those who occupy it. In a three-quarter page illustration in the editorial section of a recent Sunday edition *The Press* shows a fanciful night bird's-eye view of the city, in which the spectacular lighting proposed for the central section marks out a cross, with the City Hall at the center. That it may be otherwise fully up to the times it shows numerous airships maneuvering above the city. The explanation of this illustration runs as follows:

When the newly organized Councils provide the $60,000 required to install and operate for a year the metropolitan illumination system for the city's business streets, advocated by *The Press* and planned by Chief McLaughlin of the Electrical Bureau, the city will have added to its other distinctions the possession of the best lighted center in the United States. Philadelphia will be the bright spot of guidance to which navigators of the air will be attracted. But in a mundane way, Chestnut street and Market street, Arch, Walnut and Broad streets will be centers of life and brightness and bustle by night as they are now by day. Indeed the plans of Chief McLaughlin will in effect continue the daylight brightness until the midnight hours. All is now in readiness for the introduction of the necessary ordinance into Councils, and there is little doubt that when Market street is given its final modern pavement of wood block, the handsome ornamental standard designed by Chief McLaughlin for the center of the street between the car tracks, will be erected. On the other thoroughfares the ornamental posts will be located on the sidewalks at street intersections and midway between squares. The plans provide for 212 additional lamps to supplement the 31 now in place on Market street, from Juniper to Water streets, with eight lamps at the intersections, four between blocks on the sidewalks and four between blocks in the center of the street. The estimated cost of construction is $5450 and of maintenance for a year $18,000. There will be 80 additional lamps on Broad street, between Vine and Spruce streets, at a cost for installation and maintenance of $11,600.86; additional lights on Chestnut street from Fifth and Fifteenth streets, costing $12,200, and 61 additional lamps on Walnut street from Fifth to Fifteenth streets at a cost of $95,000. The work of installation will require only a few days.

Pittsburgh May Have Baseball at Night

NEW BASEBALL PARK TO HAVE A SPECIAL LIGHTING SYSTEM, WHICH MAY MAKE NIGHT GAMES POSSIBLE.

The following information is from the *Leader.* It is a pity that more definite details are not given. The *Leader* should put an illuminating engineer on its editorial staff:

One of the features of the new field of the Pittsburgh Baseball Club in Bellefield will be the special lighting system which will make it possible to give all sorts of entertainments at night. It is claimed that under the system that it will be possible to play baseball after dark, but even the inventor is not positive of that. A test, however, will soon be made at Cincinnati, where a similar equipment to the one contemplated for Pittsburgh is nearly completed.

Oakland, Cal., Mayor Has Own Ideas on Illuminating Engineering

THINKS THAT WELSBACH LAMPS WILL BEAT ARC LAMPS FOR STREET LIGHTING.

His opinions on this matter are thus set forth in his message to the City Council, as reported by the *Inquirer:*

In my message to the Council two years ago I recommended that gas lamps, with Welsbach burners, be substituted, in the residential sections, for the electric arc lamps. I am even more firmly convinced, now than then, that we should adopt this method as it will distribute the light better and be more satisfactory to the residents of the city. My opinion is it will entail little, if any, extra

cost and in addition result in a better distribution of light besides doing away with many unsightly poles and wires.

Ingenious "Hoosier" Has a Scheme for Abolishing Night, and Putting Artificial Light Out of Business

PROPOSES TO USE A TRAIN OF LENSES TO MAKE THE SUN'S RAYS FOLLOW THE CURVATURE OF THE EARTH.

The Utica, N. Y., *Press* is responsible for the following account of this daring scheme, which is at least as promising as some of the plans for communication with Mars, and other fantastic propositions put forth by scientists of far greater celebrity:

Gas and electric light companies will be put out of business when an invention just perfected by David R. Nicely of Petersburg, Ind., comes into general use. He has been experimenting for ten years, and now believes that he can abolish night and make the day 24 hours long. With lenses of enormous size which he will place on towers 1000 ft. high at a distance of 100 miles apart, he expects to supply daylight many hours after night has fallen. In order to keep the lenses at a proper angle a clock-work apparatus is to be provided and with the lenses so focused as to let the light in concentrated rays pass from one to the others he expects to give daylight all the time.

Miscellaneous Notes from the Field

STRAWS THAT SHOW WHICH WAY THE WIND IS BLOWING.

The Northwest Business Men's Association is a Philadelphia organization, having for its object the securing of better street lighting for its particular section of the city. The secretary of the association, Mr. James Moore, has a very clear conception of the proposition. He says:

Our organization is not fighting for more lights merely because it thinks they will add beauty to our streets. It is a well-known fact that plenty of electric lights will do more, possibly, than any other one thing to attract prospective purchasers to a certain locality. If we have an abundance of lighting facilities in the Northwest, it will tend to restrict largely the purchase of goods to our immediate locality. A development of this sort is as badly needed in this and other sections as are parks and boulevards.

Hoboken, N. J., famous in an unenviable manner as a butt of jokes by New Yorkers, now has a Citizens' Association, which is actively agitating the matter of an independent lighting plant. A company has been organized, and the stock is offered for subscription, with fair prospects of success. The company may also manufacture gas.

Richmond, Va., will expend $5000 in installing incandescent gas lamps in its streets in place of flame burners.

The Rochester Railway and Light Company, through its management, is laying plans to have the next convention of the National Electric Light Association held in that city.

Aurora, Ill., has a municipal lighting plant, which it claims is making money. The City Electrician says that the plant is worth $89,824.34, and that it cost last year $15,127.05 to operate it. It supplies 406 arc lamps, and about 800 electric lamps. The arc lamps cost $37.36 a year.

Youngstown, Ohio, business men are discussing and experimenting with street lighting. A new installation has been put up on one section of its principal business street, and the merchants on the other section have organized a committee to look after their own interests.

Springfield, Mo., merchants are still pushing for new street lighting. It is proposed that the initial cost of the installation be defrayed by the property owners, while the tenants of the respective buildings maintain the operating expenses.

The Lincoln, Neb., *Journal* contains an unusually common-sense article on "Economy of Electric Lighting." The article is unsigned, but evidently was written by an illuminating engineer.

Correspondence

From Our Baltimore Correspondent

The Consolidated Gas, Electric and Power Company, of Baltimore, was one of the first lighting companies to establish a department of illuminating engineering. Its general manager of the electrical department, Mr. Douglas A. Burnett, first conceived the idea of inaugurating such a department with an expert at its head, for the purpose of gen-

FIG. I.—ELECTRIC BULLETIN SIGN.

FIG. 2.—TAILOR SHOP ILLUMINATED WITH TUNGSTEN LAMPS.

erally improving the lighting conditions of its customers. Mr. Harry Swindell was selected from among a number of solicitors employed by the company, and since October, 1908, when his activities first took form, has devoted his entire time to this department in the interest of better illumination and the general improvement of the service. The field for his exploitation is unlimited; unlike the other solicitors, he is entirely unrestricted and free to consult with architects, builders, electrical contractors and the consumer. For example, he finds it very easy to discuss with merchants the importance of good illumination in their stores, whether in course of erection or already completed.

Although the electric and gas interests are under one executive head, the two departments are entirely independent, so far as new business is concerned, each propounding the respective merits of their illuminants, and working along competitive lines.

The electrical division handles tungsten lamps and reflectors, which are sold exclusively to its customers at prices below cost. When a customer calls at the lamp room to purchase lamps the attendant endeavors to find out whether the consumer fully understands the conditions under which the lamp should be installed in order to produce the best results, and, it it should appear that the company's expert could be of assistance, the customer is advised that a representative will gladly call and make such recommendations and suggestions as will most fully meet his requirements. The company fully realizes that the complaints of its customers, and the criticisms often heard, are occasioned primarily by the lack of knowledge and inexperience of those who design and install these lighting units; and it is to decrease and eliminate as far

FIG. 3.—SHOW WINDOWS LIGHTED WITH TUNGSTEN LAMPS.

as possible all such causes of complaints that this illuminating engineering department was created.

In connection with this policy of the company, it operates at two central locations electric sign bulletins, as shown in Fig. 1. This sign is changed every other week, and is a forceful and strictly up-to-date method of bringing to the attention of the general public the merits of electric lighting, telling them in plain, brief language what the company is doing to improve its customers' service, the advertising advantages of electric signs, and the merits of the newer illuminants, and thus acts as an interpreter between the company and the people.

By co-operating with every employee in the accomplishment of his duties the company takes a step forward in improving economic conditions within its own force. Regular meetings of employees are held; ideas and suggestions are thoroughly threshed out; the office boy and the chief clerk have the same opportunity of expressing their views for consideration; and it is through this consolidation of forces, this interchange of ideas, that the various forms of illumination are advantageously brought to the attention of the public.

The offices of the company are well illuminated, being laid out along the most modern lines; it may be truly said that "they practice what they preach." Believing that the most efficient work can only be done under the best lighting conditions, they show their faith in the methods they recommend by their own works.

The success that has resulted from the co-operation of the lighting expert and the customers is shown in Fig. 2, the new shop of one of Baltimore's most prominent tailors. The photograph gives a view of the entire store and window; a most satisfactory illumination prevails

throughout. The original scheme of lighting as proposed to the owner by the consulting engineers was for the installation of two rows of five light clusters, 12 feet apart. When this plan was submitted to the lighting company's representative he pointed out the fact that the ceiling is extremely low, not over 9 feet, and the entire width approximately 20 feet, and explained the advantages of individual units; and in order to make the argument more convincing the customer was taken to see several very conspicuous lighting installations. After devoting the necessary time to fully explain the importance of proper lighting units, the customer readily appreciated the interest displayed in his behalf, canceled the original plans and substituted those outlined by the electric company, which covers the installation of 23 tungsten units, equally spaced over an area of approximately 2000 square feet, the window being equipped with five 40-watt units.

Another prominent installation designed under the supervision of the lighting company is shown in Fig. 3. This entire five-story building, devoted to the sale of fine furniture and house furnishings, is illuminated with tungsten lamps and prismatic reflectors. The windows, as shown on the photo, are exceptionally well lighted, fifty-four lamps being used.

Another phase of the illuminating problem in Baltimore has been the criticism directed to the lighting company by the residence consumer of the results obtained in this branch of service. After due investigation it has been found that the fault very often lies in the use of colored glass domes in dining rooms, libraries and living rooms, to misplaced wall brackets and dark furnishings.

The company has also issued to its customers a booklet entitled "Illumination on Current Topics," wherein a frank statement is made of the elements that go to make up the charge for service, and in it are explained technical terms that have heretofore been unintelligible to the average customer.

SYDNEY C. BLUMENTHAL.

From Our Berlin Correspondent

With the departing of the winter a serious danger threatening the German illuminating industries has also gone; for the first spring day brought the decision against the projected tax on electricity and gas, the details of which the writer has given in a previous issue of THE ILLUMINATING ENGINEER. It was the last week of March when I went to the Reichstag, where the Commission of Finance had assembled to say the last word in regard to the proposed tax. Long before the beginning, servants carried piles of papers into the chamber. They had to exert all their physical power to carry three books of unusual size and weight. These big volumes were neatly bound, and bore in golden letters the same title: "Protests Against the Gas and Electricity Tax." The first book contained the protests and petitions received by the Society of German Gas and Electrical Fitters; the second those of the League of Coppersmiths and Plumbers; and the third volume the protests received by the Water and Light Association, to which the manufacturers in the illuminating industry belonged. There were thousands of letters collected, and these were laid before the Reichstag.

The special conference of the finance department was not a public one, and our patience was somewhat taxed; but after three hours' waiting the decision was reached, to the effect that the proposed tax, having depressed the German illuminating industry for several months, be rejected. It was asserted that manufacturers, tradesmen, employees, power station companies, municipalities, and also the general public were bitterly complaining and feared great losses if such a project should become a law. Many smaller plants and workshops would be wiped out; competition with foreign countries would become more serious; and by taxing gas and electric current we would return to the old fashioned oil lamp.

MAX A. R. BRÜNNER.

From Our Readers

CLEVELAND, April 24, 1909.

To the Editor of The Illuminating Engineer, New York City.

Gentlemen: The unsigned article appearing on page 680 of your February number has just come to our notice.

We cannot believe that this is an attack on the position of the Tungstolier

Company in the illuminating field, or a deliberate attempt to belittle any one connected with it.

You admit that the Tungstolier Company is to be commended for its originality and progressive spirit, and yet you seemingly criticise the general policy of the company or certain individuals connected with the company, as a result of a difference in opinion between us on possibly one or two small issues.

Ever since the inception, it seemed to be a case of the "Tungstolier against the field." If lighting conditions are to be improved, and that is what the Tungstolier Company was incorporated for (and we understand THE ILLUMINATING ENGINEER was founded on the same policy), interests of similar character should work together, and not resort to mud slinging.

It is true that we took exception to an article published in THE ILLUMINATING ENGINEER some months ago. Possibly we should not have considered this article seriously, but it contained a great many expressions, almost word for word, as they appeared in advertising sent out by the Tungstolier Company.

It made strong reference to "fake illuminating engineering" simply as a blind to dispose of their commodity. Since our language had been used so often in this article, we felt that it was an attack on us under cover, and we, therefore, felt justified in replying to this editorial in the January number of the *Illuminator,* which brought forth your unsigned article referred to.

We have been spending a tremendous amount of money promoting the tungsten. We do not sell tungsten lamps only, and derive no benefit from tungsten lamp sales. To bring out the "Tungstolier"—the unit—we readily saw it was necessary to first make known the properties of the tungsten lamp. We are appealing to a large, promiscuous body of people, who do not require technical explanations, but the simplest presentation of the proposition. The phenomena of the tungsten can be comprehended by any one—and the simpler the explanation, the better.

Of the thousands of dollars we have spent in this proposition, scattering an enormous amount of tungsten publicity, our material benefits have been very small. Doubtless, others engaged in a similar line of business have reaped as much benefit from our advertising as we have ourselves, and so we feel that we have done the general illumination proposition as much good as any other interest in the country.

Naturally, we consider ourselves illuminating engineers and believe we have been a strong national factor in this work. In the short period of our operations we have over 3000 direct accounts on our books, and through our various selling channels have made a great many times that number of installations, and have many endorsements.

It is true that some illuminating engineers disagree with us on some things. It will not be until the millennium when all will agree on a subject as broad as the illuminating question.

It is true that all of the employees of this company are not technical illuminating engineers. We have, however, in our organization men whose opinion on illuminating subjects are recognized against those of any one else in the field. It is from the work of these men that our organization has been able to learn something at least of illuminating engineering, and we believe in the short ten months of our operations we have a larger percentage of men who know commercial illuminating engineering than any other company operating in the United States to-day.

We are in the game to stay. We, therefore, address you thus, believing you will print this article in the editorial columns of your paper, so your readers will not understand what has previously appeared in THE ILLUMINATING ENGINEER as an unfriendly attitude of your paper to the Tungstolier Company, or a vast difference in opinion on the subject of illumination.

We hope this letter will settle the controversy between THE ILLUMINATING ENGINEER and *The Illuminator.*

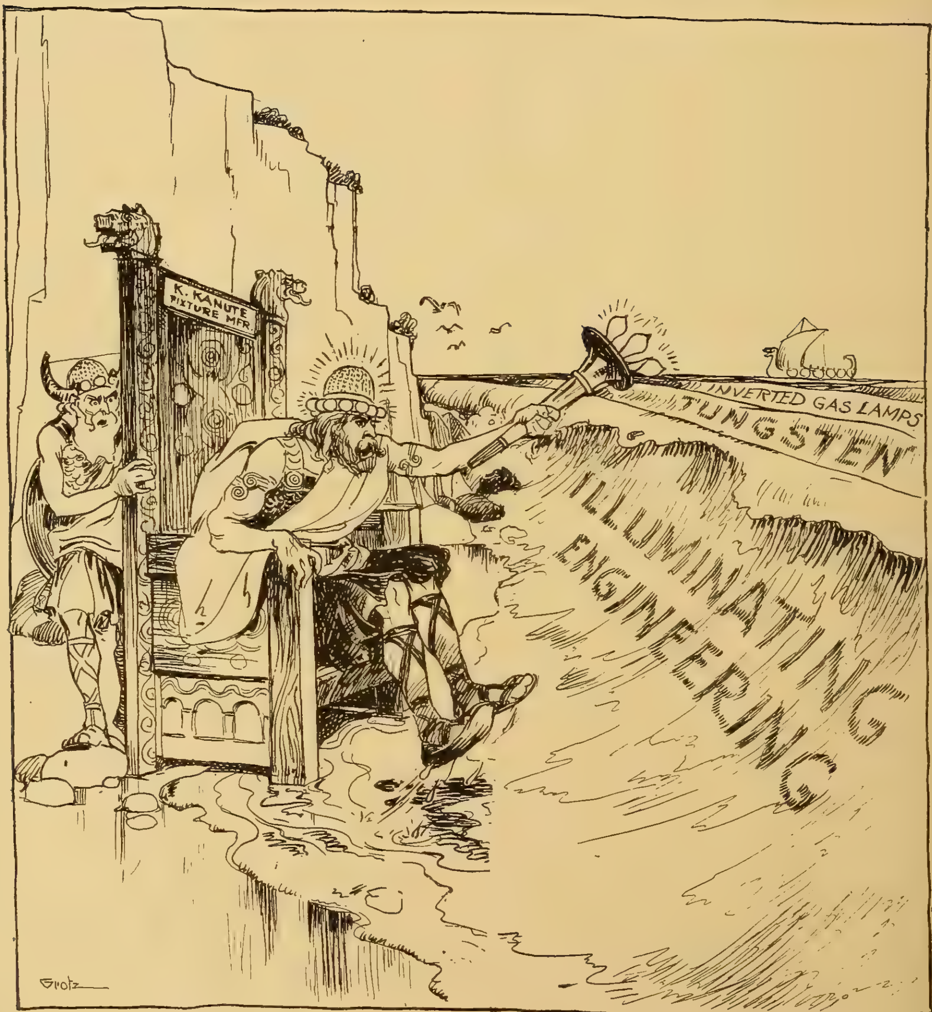
Very truly yours,

THE TUNGSTOLIER CO.

MILTON HARTMAN,

CASHIER BOOKKEEPER CONTRACTS ADVERTISING

Commercial Engineering of Illumination



A Modern King Kanute

Legend says that this ancient king solemnly commanded the tide to stay back. There are a few modern instances among the fixture manufacturers.

The Ethics of Advertising

Ethics may be roughly defined, for the purpose of this discussion, as the science of right and wrong. In civilized countries laws are formulated, based theoretically at least upon this science, and intended as a guide for all who come under their jurisdiction. The human mind and conscience, however, is far too versatile and elusive to be circumscribed by any code of rules or formulas. It is always possible to evade written laws, but there is no possibility of evading the conscience and the broad principles of right and justice which it unerringly sets forth. Where material ends are concerned, as in trade and commerce, laws may be pretty definitely formulated concerning them; but in the numerous relations of civilized man in which there is only commerce of words and ideas, laws are far more difficult to prescribe.

It thus happens that there are comparatively few statutes governing that class of labor and service which is comprehended by the general term profession. Against the lawyer, physician, clergyman or engineer who gives wrong advice it is difficult to prosecute an action at law, though the damages sustained by faulty service be real and severe. Civilized society could not possibly exist otherwise than on a basis of general honesty between its members; and the codes of professional ethics, though not enforced by legal enactments, are quite as binding upon all members of the professions as if the usual legal penalties were inflicted. Sometimes efforts are made to reduce such codes to written forms—as, for instance, the code for electrical engineers, which was formulated by the American Institute.

Advertising is one of the greatest institutions of modern civilization. It needs only the most casual observation to give an idea of the enormous amount of money which is annually expended for this purpose. Advertising may be fairly classed among the professions. The advertising, or "publicity" manager of a commercial corporation occupies one of the most important and responsible positions in the business; and the professional advertiser who seeks a general clientele has still greater responsibilities. The millions of dollars annually expended are a sufficient proof of the power of advertising. There can be no escaping the fact, therefore, that, whether he recognizes it or not, the advertiser is bound to observe certain ethical principles quite as much as the member of any other profession. Sharp practices, ingenious subterfuges and alluring misrepresentation may gain temporary custom; but so may chicanery and malpractice bring remuneration to the lawyer and doctor of easy conscience.

Sins in advertising may be either of commission or omission. An advertisement may mislead by making positively false statements, or by omitting to state the whole case; the two are about equally reprehensible.

There is one problem in advertising which requires especially careful consideration: In the present conditions and traditions of commerce, what may a tradesman say of his competitors? This is an even nicer question than what he may leave unsaid regarding his own wares. There can be little valid objection to the statement of absolutely established facts regarding products of similar kind of other manufacture; but the truth of such statements must be unquestioned, and the statements made in such a simple and plain form as to leave no possible room for doubt as to their exact meaning. Public opinion has also established the principle that, so far as possible, statements in regard to competing products must be general in their character, and not made with reference to specific persons or firms. The implied slur, or innuendo, is despicable for the same reason that the blow in the dark is reprehensible; it offers no opportunity for defense or retaliation. As Voltaire well says, "What reply can be made to a sneer?"

The misstatement of facts concerning competing products or goods is self-evidently unethical; and it has come to be recognized by the best elements in modern commerce that the safest plan is to say nothing at all in regard to competing products, and, within reasonable limits,

not even to reply when false statements or aspersions are made. Positivism is unquestionably the true philosophy for the advertiser. Let each present his own case with all the persuasiveness and vigor possible consistent with the truth, and stop there. There is something essentially mean and little in attempting to promote one's own good by injuring others.

The sense of fair play can be relied upon to prevail in the long run. Undoubtedly "honesty is the best policy," which fact has no small part in preserving a good working balance of honesty among civilized men. The man who proclaims the sins and shortcomings of his neighbors at once draws suspicion upon his own motives and actions. The advertiser who wantonly attacks the motives or goods of his competitor defeats his own purpose in two ways: he arouses suspicions as to his own honesty and enlists the sympathy of the prospective customer in behalf of the person attacked, for nothing is more natural than to side with "the under dog in the fight." There are plenty of cases on record, and doubtless the reader can cite one or more from his own experience, where an unethical attack upon a competitor has diverted an order for goods directly into that competitor's hands. Whatever other attractions an advertisement may possess, if it lacks the spirit of candor and sincerity it will fall wide of its mark.

A particularly flagrant case of unethical advertising has recently come to our attention, and was the immediate inspiration of this general discussion of the subject. It is regretable that this particular case happens to emanate from a source which we have already had occasion to criticise, since a second criticism may possibly carry the idea of a personal animus. The subject in itself, however, should successfully refute any such imputation. A certain fixture concern has been uncommonly active in its advertising propaganda setting forth the advantages of its particular make of fixtures for tungsten electric lamps, and has reaped a large reward by way of sales of its products. Flushed with this victory, its advertising department seems to have suddenly longed for new fields to conquer, and has launched a most vicious and ill-advised attack upon gas lighting in general. The first onslaught consisted in the distribution of a mailing card, on the front of which loomed big the familiar skull and cross-bones, with the word "poison" underneath. On the back of the card was the following text:

"How many times do you see a shopper go into a gas light store, put her hand on her chest and gasp! The place is flat and heavy, and the same stupefying effect is noticeable in your clerks. They are languid, heavy-eyed, because they are breathing air a good portion of which is poison —rank poison—and they breathe it all day. The shopper can't tell green from blue, catches the atmosphere of gloom and leaves the place. . . . You draw people into your store—and your light drives them out. Gas is poison. It poisons the air and your business as well.

"(Signed)

"THE TUNGSTOLIER COMPANY."

This was followed by a second charge in the way of a still larger card, printed on lurid red paper, with the same emblem on the front and the following argument on the back:

"Anti-Gas: People come into your store to buy or to look around—and go somewhere else to buy. You employ all of the known ways to hold them and make them buy of you. You have a handy elevator service; floor walkers directing them to the department they seek; big figures to induce them to stop; special sales; all these and many more to make people take in hand your goods and look at them. . . . How do you expect to make sales when your illumination is dead set against your plans?"

The first argument leaves the reader in doubt as to whether it is the gas lighted store or the chest of the female shopper that is flat; but that is rather beside the point. The transgression of ethics here is twofold: there is a positive misstatement of fact, and as strong an attempt to create a false impression of the results of gas lighting as the writer is capable of making. In a room as well ventilated as the ordinary store there is no occasion for any one to become heavy-eyed or languid because of gas illumination. The statement that a "good portion" of the air is "rank poison" is, to put it mildly,

malicious mischief; it is not true, and is made with malice aforethought. The shopper who cannot tell green from blue under modern gas light is color blind. It is a scientifically established fact, capable of the simplest verification, that the mantle gas lamp gives a light fully as near daylight in color value as the tungsten or Nernst lamp, and is surpassed only by the carbon arc carefully tempered with opalescent globes. The statement that "gas is poisonous" is technically true, but this does not apply to the products of its combustion. The statement is a subterfuge intended to scare the unsophisticated. What would be thought of the maker of gas fixtures who would dwell upon the use of electricity in the execution of criminals as a reason for not using it for store illumination? What is sauce for the goose is sauce for the gander. As a piece of foolishly aggressive advertising matter this caps anything that has ever come to our notice.

We have always prided ourselves on the fact that in America the two competing lighting interests do not waste their time or energy on scurrilous attacks upon each other, and have sometimes twitted our English neighbors of tendencies in this direction. But while the feeling sometimes runs rather high in the "little island," the Briton's sense of decency and dignity has prevented any such nauseous outbreaks as the one cited.

Even overlooking what might be called the theoretical ethics of the case, it is absolutely incomprehensible that a concern manufacturing fixtures, which presumably it could find as large a market for in the gas field as in the electric, without arousing the slightest ill feeling on either side, should thus deliberately slap in the face an interest which might well double its sales.

We can see only one possible good to come from this ill-conceived attack, and that is a more vigorous campaign on the part of the gas interests to compete with electric lighting on the grounds of quality, as well as economy. How long will they continue to keep silent concerning their own demonstrable virtues, in the face of the unceasing claims of the electric light for superiority in quality of illumination?

Street Lighting in Boston

By L. D. Gibbs.

The people are welcoming everywhere the tungsten street light. We have given them model fixtures, and the streets are becoming better and better illuminated. Here in Boston we are making some demonstrations of improved street lighting. On Commonwealth avenue, Boylston street and around the Common we have placed on poles about thirty-five feet high some new magnetite lamps. The poles are shapely, of wood, and are in many instances set into inconspicuous iron sockets which hold them upright, although the poles may be easily removed. The sockets can be set into the pavement or edge of the sidewalk very easily. The lamps burn with a steady glow, and although of high candle-power, the light is diffused through opal globes and thrown downward with satisfactory shades.

We are also using, for experimental purposes, a few flaming arcs. We have three erected in Copley square. They are on poles which bring the light over fifty feet from the surface of the street. The poles are slim, trim and not ungraceful, and the goose-necks are of a design in keeping; it is noteworthy that we have received no adverse criticism from the worshippers of art in city life or from any who have the interests of the appearance of Copley square most at heart. Two more of these lights on a trim fixture are hanging at the same height above the street in Park square. The light is very agreeable and the daily papers have commented pleasantly upon the results.

"All but six of the 32 cities and towns which light their streets with electricity from the Edison Company's service are now using the new improved tungsten street lamps. Several of the six towns

(probably all) will adopt the tungsten light as soon as arrangements can be made for changing over old contracts. These changes the Edison Company is always willing to make. The Edison's attitude in this matter of supplying towns with the latest street lighting improvements and affording them the best possible rates for service, is best demonstrated in the case of one of the towns where a contract for street lighting was entered into four years ago, the contract to cover a period of five years. The Edison Company has voluntarily reduced the rates for street lighting in that town twice in the four years that the contract has run. Such advance steps naturally win the hearty commendation and co-operation, not only of the town officials, who have reason to be proud of their official foresight, but the inhabitants, who welcome increased illumination.

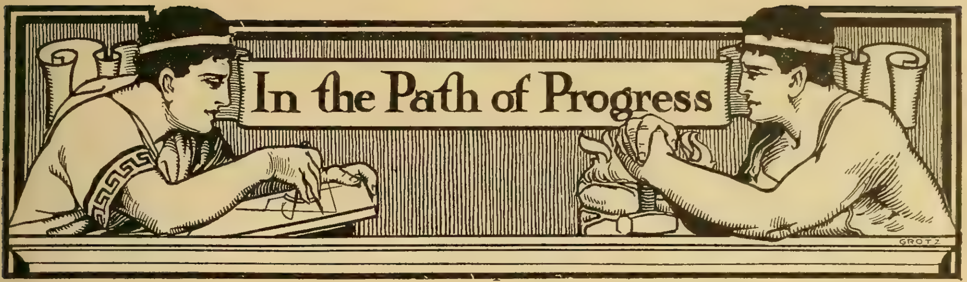
"Tungsten lamps mean everywhere an increase of 40 to 60 per cent. in the amount of light secured, and also reduce the cost in some cases nearly one-half. In every case the cities and towns that have adopted the tungsten lamps have declined to take advantage of this economy by cutting down their appropriation. They have much preferred to increase the amount of light and the hours of burning.

"Until recent years there has been a tendency to forget the welfare of the worthy citizens whose duties call them out late at night or early in the morning. The police, physicians, milkmen and produce dealers have had to stumble through dark streets as best they could, because the average person has thought because he is usually in bed before midnight that the minority could get along in the best way possible. The forgetfulness is passing to a degree, and in many towns provision is made for the special lighting of the streets in the dark hours of the early morning for the convenience of the milkmen and produce dealers. A great element of safety comes to the householder and the business man by keeping the streets lighted after midnight. These late hours are the time when the most burglaries and other crimes are perpetrated. The criminal dreads the light. It is additionally important to afford ample facilities for his capture, and one of these is bright streets."

Refinishing Fixtures By Lighting Companies

The refinishing of lighting fixtures by lighting companies is becoming an important and profitable department of work at many plants. Several important makers of supplies for electro-plating state that their business for account of lighting companies which carry on a fixture business has doubled within three years. During the height of the past industrial prosperity so busy were the fixture makers and electro-plating shops of the country that they could not undertake all the business that was offered by lighting companies and electrical contractors for refinishing fixtures; and this condition led them to install their own plants. For a time these new refinishing plants were hampered by inability to obtain an adequate number of competent operatives, but to-day all the skilled men who are required may be had, and the business is assuming large dimensions.

The number of men and women employed in these plating and refinishing plants ranges from ten to one hundred persons. A New England plant of this kind was established a couple of years ago by the manager of a lighting company, who obtained the permission of his directors to take up the work for the main purpose of giving prompt attention to fixture refinishing, which hitherto had been done by concerns outside the State. The plant was begun with two hands, and has been developed to a state wherein forty-six persons are employed, and is soon to be doubled in capacity.



"The Path of Progress" Leads to the National Electric Light Association Convention, Young's Million Dollar Pier, Atlantic City, N. J., Tuesday, Wednesday, Thursday and Friday, June 1, 2, 3 and 4

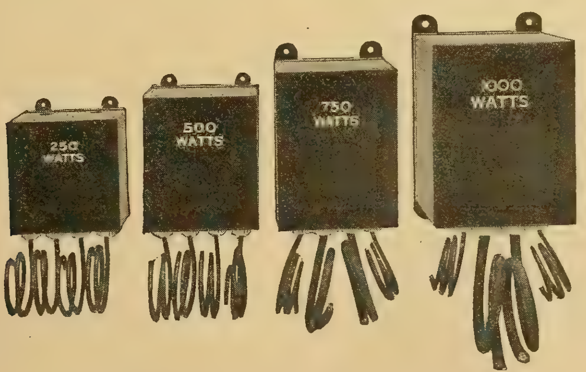
Transformers for Tungsten Lamps

We recently called attention to the conditions that were bound to make the use of small incandescent lamp units, i. e., of 16 candle power and under, continue for a long time to come, and also pointed out how readily the tungsten lamp can be adopted to these conditions by the simple expedient of transforming to lower voltages than those now common. The use of small lamps in signs has made such a practice absolutely essential, in order to secure the benefits in efficiency of the new lamp, and we believe that similar practices will be followed to a greater or less extent in private lighting. We, therefore, take pleasure in calling attention to a line of transformers especially designed for this purpose.

The Thordarson Electric Manufacturing Company of Chicago have designed and have ready for the market a line of transformers for low voltage tungsten lamps ranging in capacity from 150 watts to 1000 watts, with a standard secondary output of 10 volts.

These transformers embody all essentials of most perfect design, electrically, magnetically and mechanically. Their design enables the use of a very short and compact magnetic and electric circuit, thereby reducing the weight to a minimum. For this reason they are especially adapted for sign lighting.

The present demand is for sign lighting, but residences will soon accept this big saving in the consumption of current. Especially when 20-volt 16-candle power 20-watt lamps are put on the market, which is but a question of a few months.



TYPES OF THORDARSON TRANSFORMERS.

Proceedings of Technical Societies

Papers Presented Before the Illuminating Engineering Society

NEW YORK SECTION.

THE MATHEMATICAL THEORY OF FINITE SURFACE LIGHT SOURCES, by Bassett Jones, Jr.

From a purely mathematical consideration of the problem Mr. Jones derives certain simple formulas which are useful in the practical work of laying out illumination, especially where indirect methods or illumination through glass ceilings is used.

THE ILLUMINATION OF THE EDITORIAL OFFICES OF THE NEW YORK WORLD, by Albert J. Marshall.

This is a description of the new lighting installation of these offices, which is of special interest as being the first practical case of the use of the combination of mercury vapor lamps with tungsten lamps. The writer gives a technical description of the installation, together with the results of illuminometer measurements. The discussion elicited the fact that the results were highly satisfactory to those working under the illumination.

THE CALCULATION OF ILLUMINATION, by A. A. Wohlauer.

Mr. Wohlauer described what is generally known as the "flux of light method" of laying out illuminating installations.

THE EFFICIENCY OF THE SMALL MANTLE BURNER, by Norman Macbeth.

The paper brought out the interesting fact that the small mantle burner, of the type which is sold as a complete unit, including burner, mantle and chimney, is the most efficient of all gas lamps. Comparisons were also drawn between the cost of light produced by such units and by the various electric lamps.

PHILADELPHIA SECTION.

MEASURING SPHERICAL CANDLE POWER BY AVERAGING THE EQUAL SUB-DIVISION OF THE SPHERE, by Carl Hering.

Professor Hering in this paper gives an exceedingly clear exposition of the troublesome problem of spherical candle power. He makes the use of prospective drawing, as well as diagrams, in order to make the matter plain.

THE ILLUMINATION OF HAMMERSTEIN'S PHILADELPHIA OPERA HOUSE, by Arthur J. Spillman.

Mr. Spillman's description of this installation was given as a lecture with lantern slide illustrations.

CHICAGO SECTION.

SOME NOTES AND TESTS ON INDIRECT ILLUMINATION, by J. R. Cravath.

The paper deals particularly with the special method of indirect lighting which has been largely exploited in a commercial way of late.

MODERN FIXTURE DESIGN, by Charles A. Luther.

This was the subject of an informal address given by Mr. Luther at a noon meeting of the section.

BOSTON SECTION.

THE SIMPLIFICATION OF ILLUMINATION PROBLEMS THROUGH THE CONCEPTION OF LIGHT FLUX, by J. S. Codman.

The special feature of this paper is a complete list of references to all articles

that have appeared recently on this particular subject in the various technical journals.

STORE WINDOW AND SIGN LIGHTING, by L. D. Gibbs.

An informal address on this subject, given with lantern slide illustrations.

HIGH CANDLE POWER ILLUMINANTS—GAS VS. ELECTRICITY, by J. Earl King. Presented at the First Annual Meeting of the Indiana Gas Association, at Indianapolis, January 20, 21, 1909.

The writer makes careful comparisons of the light produced by tungsten lamp clusters and chandeliers with that given by inverted gas lamps. Distribution curves are shown, and the subject is treated in a very careful and thorough manner. The relative cost of producing light by these two modern methods is also given in the form of a chart. Altogether it is perhaps the most definite and exact treatment of this particular subject that has thus far been published.

His own conclusions are as follows:

"While it is quite true great improvements in electric lighting have been made, it is also true great strides have been made in incandescent gas lighting and to-day the gas man is just as far ahead of the electric man in the lighting proposition as he was when the comparison was made between the gas arc and the electric arc, or between the single upright mantle lights and the carbon filament lamps.

"It is obvious that to underestimate the strength of a competitor is a serious error. It is also obvious that to overestimate this strength shows poor judgment.

"The introduction of the competition offered gas lighting by the tungsten electric lamps has caused much uneasiness, and many a gas manager has seen that serious inroads might possibly be made upon his illuminating output if he was obliged to compete with the new electric proposition along the old lines. In fact, the electric companies have, in some localities, secured a considerable increase in send-out at the expense of the illuminating send-out of the gas companies.

"The electric cry being increased light at less cost, and the gas companies with the old lighting systems having nothing new to offer their customer either in style of fixture or increased efficiency of illumination, it has not been particularly hard to convince a consumer sufficiently to secure the business for the electric company.

"A new lighting device always finds a following. If it is of special merit it soon has a large patronage, and almost any gas lighting system favored and promoted by a gas company will be taken up readily by the public, the public's experience being that the gas company wishes to give the most light for the least cost.

"As the electric proposition is new, it naturally follows that unless something new is offered in competition, it will secure a considerable following which it would not be able to obtain, if the gas lighting offered in its stead is of the up-to-date order and gives increased illumination at a decreased cost. Gas men, realizing this, have always adopted new devices of merit even if the new appliance reduced the output of their product temporarily."

THE STORY OF A SUCCESSFUL SIGN CAMPAIGN, by J. B. Lindl. Presented at the Ninth Annual Convention of the Iowa Electrical Association, at Cedar Rapids, April 21, 22.

The writer describes in a very attractive manner the means used to create a Great White Way in the city of Dubuque.

THE EFFECT ON CENTRAL STATION REVENUES THROUGH THE INTRODUCTION OF THE TUNGSTEN LAMP, by Thomas Ferris. Presented at the Ninth Annual Convention of the Iowa Electrical Association.

The writer comes to the conclusion that the introduction of the tungsten lamp will ultimately increase central station revenues. His chief reason for reaching this conclusion is that the better quality of light at less cost will induce a great many people to use the electric light, who otherwise would not do so, and that many of those who find their lighting bills reduced will more than make up by using current for fans and other purposes.

Review of the Technical Press

American Items

ILLUMINATION.

This is the title of a new periodical, the first number of which is dated April. It is published by Illumination Publishing Company, 324 Dearborn Street, Chicago.

A short introductory editorial announces that it is to be a strictly trade periodical. In accordance with this plan, the first issue contains a number of articles dealing with the trade or commercial side of lighting. The proprietors make no claims whatever to technical knowledge of the subject, or to any recognition of illuminating engineering as a science or profession. Aside from the short introductory notice referred to there is no editorial department. This omission, however, does not in any way distinguish this journal from others of its class. It seems to be accepted, at least by this class of periodicals themselves, that such a thing as an editorial policy or department is a wholly unnecessary refinement in trade journalism.

It would be too much in the nature of prophesy to predict the future of this new number of the trade journal fraternity; further issues will develop its scope and probable future. It would seem that the lighting field is large enough to support a number of class papers; but between the supposition and the hard reality there is a considerable gap. The publishers of "Illumination" have our good wishes.

Low Voltage Tungsten Sign Lamps in Denver; *Electrical World,* April 15.

A description, with an illustration and diagram, of the outline and sign lighting of the Denver Gas and Electric Company's Building.

Light and Illumination; *Light,* April.

Under this department heading Mr. A. J. Marshall in his second chapter discesses: The Measure of Light; The Measure of Illumination; Light and Illumination; Illuminating Engineering; The Field of Illuminating Engineering; Breadth of Knowledge Required.

The Lighting of One Suburban Theater, by M. H. Spear; *American Gas Light Journal,* May 3.

A short article describing a successful installation of gas arc lamps with self-lighting mantles in a small theater.

Comparison of Gas Arcs, Flame Arcs and Series Tungsten Arches for Business District Street Lighting, by H. W. Hillman; *Electrical World,* April 22.

The article gives the writer's observations on the various systems of spectacular lighting, all leading to the conclusion that tungsten arches over the streets afford the best results for a given expenditure of money.

" A year or more ago a street in Grand Rapids, Mich., 1800 feet long, was lighted by merchants with series-tungsten lamps suspended on arches about 100 feet apart. The merchants on this particular street were especially well satisfied with the illumination from every viewpoint. On another street, in connection with which new illumination was being considered, the merchants wanted to see a display of gas arcs before deciding up on the series-tungsten system. Accordingly poles were set about 50 feet apart, staggered on either side of the street. Two gas lamps

were installed on each pole. Inverted mantles were used, and the outer globe of the arc suspended at the top. The illumination was good when compared with the old method of lighting, but the volume of light and the perfect distribution secured by the tungsten arches gave evidence of the marked superiority of the tungsten arches over the gas arcs.

"When the subject of cost was investigated it was found that for the number of gas arcs required to produce an illumination effect anywhere near equal to that of the series-tungsten system, the bid for gas lighting was nearly twice as much as for the series-tungsten lighting.

"Before the trial was finished, and during the cold weather season, the outer globes from the gas arcs were continually dropping on the street, causing uncomplimentary comments.

"I have recently seen, in another city, a merchants' district illuminated with short burning-flame arcs. There were two arcs suspended in front of each store, regardless of frontage, the small and large front being treated alike. The street was not more than 55 feet wide, and the lamps were suspended not higher than 18 feet. A great volume of illumination was exhibited, greater perhaps than has been used in any street heretofore. There would seem to be no question whatever about the volume of light furnished, except that the street might be considered over-illuminated.

"As to attendance, the flame arcs are short-burning; they need attention every day and trimmers must come with their step ladders and carbons to place the lamps in condition to burn another night. This practice was long ago abandoned when the short-burning open arcs were replaced by long-burning enclosed arcs, and as regards attendance the short burning flame arcs represent a step backward.

"Considering the cost of operating, the long life of the series-tungsten lamps makes the renewal cost very low. The energy used per 100 feet of street is slightly more than 1 kw.—in fact, 14 lamps consume 75 watts each, or 1050 watts. Two or three times this amount of energy is, therefore, required to operate the arrangement of flame arcs before referred to. The cost of carbons, the cost of labor and the current consumed by the flame arcs make operating expensive compared with the tungsten arches."

Street Lighting of New Orleans; *Electrical Review and Western Electrician*, April 24.

Gives a number of illustrations and a short description of the spectacular lighting of the city during Mardi Gras week.

Ornamental Street Lighting at Des Moines, Iowa, by P. D. Sawyer; *Electrical World*, May 6th.

Describes the system now being installed in this city through the efforts of the Commercial Club. In speaking of the present movement for better street lighting Mr. Sawyer sizes up the general situation thus:

"The forms of lighting range from the temporary installation of festoons of incandescent lamps, which look well at night, but are unsightly by day, to the premature installations of artistic systems for continued and efficient service. The best form is that which will give effective lighting, be permanent, and makes a good appearance at all times."

The details of the installation are as follows:

The post adopted is 13 ft. 7½ in. high over all, with four 1-ft. 9-in. arms, and one lamp in the center. The light is supplied by five 100-watt tungsten lamps, enclosed in pale opalescent globes; the top globe is 12 in. in diameter and 2 in. larger than the four pendant ones. The posts are set 56 ft. from center to center, starting at the street intersection at a point on the curbing opposite the outside property line. The posts are paid for by the owners of the abutting property at the rate of $85 per post, which is sufficient to cover the cost erected.

Light and the Church, by Earle E. Whitehorn; *Selling Electricity*, April.

Mr. Whitehorn seeks to justify the use of spectacular lighting by churches, and illustrates his article with a number of examples. His arguments are dignified, and the article of more than usual literary merit.

Experience with High Efficiency Lamps in Industrial Plants, by Warren H. Miller; *Electrical World*, May 6.

An exceptionally valuable article giving the results of actual use of the new high efficiency incandescent lamps and flaming arcs. In all cases 25-cycle a. c. current was used, which gives additional value to the results. The writer states that with incandescent lamps flicker was absolutely indiscernible. In the case of the flaming arcs those with motor driven feeding mechanisms operated very smoothly, whereas those with solenoid control were unsatisfactory. Flicker was not at all disagreeable out of doors, but inside of small buildings or near walls, the light would hardly do to work by. The breakage of filaments in 100-watt tungsten lamps in the shops where there was jar and vibration was very large, and tantalum lamps gave little better satisfaction. Fifty and 20 c. p. metal filament lamps, however, were found satisfactory. The writer prefers tungsten clusters to flaming arcs for yard lighting on account of wider distribution.

Foreign Items

COMPILED BY J. S. DOW.

ILLUMINATION AND PHOTOMETRY.

EDITORIALS.

THE EVOLUTION OF THE ILLUMINATING ENGINEER (*J. G. L.*, April 13).

PROGRESS IN ILLUMINATING ENGINEERING (*Gas Engineer's Magazine*, April 15).

PROGRESS IN ILLUMINATING ENGINEERING (*J. G. L.*, April 13).

Editorials commenting generally upon the progress of illuminating engineering. The first named deals chiefly with recent remarks in the *Illuminating Engineer* (London), expressing the view that, while approving the new movement, the writer does not see the ideal expert illuminating engineer developing as quickly as might be desired.

THE PRODUCTION AND UTILIZATION OF LIGHT (continued), by Dr. C. V. Drysdale (*The Illuminating Engineer*, London, April).

THE EFFECT OF LIGHT OF DIFFERENT COLORS UPON VISUAL ACUITY, by J. S. Dow.

The author describes some experiments which lead him to suppose that visual acuity cannot readily be made the basis of photometrical measurement. It is also suggested that red light is the best for distant vision, blue-violet light on the other hand, being somewhat better for near work.

GRAPHISCHE BESTIMMUNG DER BELEUCHTUNG HORIZONTALER BODENFLÄCHEN, by R. Edler (*Elek u. Masch.*, March 28).

The writer describes a series of graphical constructions which facilitate the calculation of the ground-illumination at any point from a source, of specified characteristics as regards intensity and distribution of light, and hung at a certain height above the ground.

A NEW STANDARD OF LIGHT, by W. A. Harwood (*Electrician*, April 16).

The author suggests a new form of light-standard, consisting of a platinum strip brought to a specified temperature of incandescence; this is accurately determined by means of a special device balancing the radiation passing through a plate of black fluorspar and a vessel of water respectively.

UEBER DIE BESTIMMUNG DER AEQUIVALENTWERTE VERSCHIEDENFARBIGER LICHTQUELLEN NACH DER METHODE DER FLÄCHENHELLIGKEIT SEHSCHARFE, UND FLIMMERPHOTOMETRIE, by J. Stuhr.

A treatise recently published under the direction of the University at Kiel. The author seeks to compare the photometric methods of Equality of Brightness, Acuteness of Vision, and Flicker, as a means of comparing sources of light which differ in color.

Die einfachste Methode zur Ermittlung der Mittleren sphärischen und hemisphärischen Lichtstärke aus der Licht-Lichtverteilungskurve, by J. K. Sumec (*Elek. u. Masch*, April 4).

Describes a method of calculating mean spherical and hemispherical candle power from the curve of light-distribution of an illuminant, which the author considers the simplest yet devised.

Illumination, Its Distribution and Measurement, by A. P. Trotter (*Illuminating Engineer*, London, April, Continued).

The present section of this article deals mainly with Photometric Scales and the Calibration of Benches direct in candle power.

Zur Lichtschwerpunkt-Bestimmung, by R. Ulbricht (*E. T. Z.*, April 8).

Describes a form of apparatus for the purpose of determining the "center of radiation" of a source of light.

The Report of the National Physical Laboratory for the Past Year.

Describes the most recent additions to the photometrical equipment of the laboratory in the past year, and gives a *résumé* of the work of the laboratory.

The Eye-Sight Troubles of Wireless Telegraphy Operators, by Dr. P. Bellisle (Archieves de Médecine Navale, March; abstracted in *The Illuminating Engineer*, London, April).

Describes the deterioration in eye-sight experienced by certain operators on board French warships, which are ascribed mainly to the effect of the ultra-violet light in the spark emitted from the transmitting apparatus. The author seems to suggest that the actual wireless electromagnetic waves may also be responsible for mischief.

The Historical Development of Street Lighting in London in the Seventeenth and Eighteenth Centuries (*The Illuminating Engineer*, London, April).

The Lighting of the City of London (*G. W.*, April 14).

An interview with a member of the Committee which recently visited Continental cities to report upon the lighting there, with a view to introducing modifications in the streets of London.

ELECTRIC LIGHTING.

EDITORIALS.

The Central Station and the Small Consumer (*Elec. Engineer*, April 23).

Die Anwendung der Gaedepumpe zur Fabrikation von Metallfadenlampen, mit experimenten und Demonstrationen, by G. Meyer (*E. T. Z.*, April 8).

Describes the application of a new type of exhausting pump to the manufacture of metallic filament lamps.

Fortschritte der Bogenlampentechnik, by B. Monasch (*E. T. Z.*, April 15, 22).

An article reviewing recent progress in arc lamps. Special mention is made of the new Blondel cored carbons which yield a flame arc, but can be used with vertical electrodes.

Das Komparessions-Vakuummeter in der Glühlampenfabrik, by H. T. Reiff (*Elek. Anz.*, April 22, 25).

Über Zentralanlagen in russischen Städten, by C. Schmidt (*E. T. Z.*, April 15).

Discusses the conditions prevalent in Russian towns lighted by electricity; as a rule such towns are extended over a very wide area and, when not lighted by electricity, use oil-lamps at intervals. These, the author suggests, could be profitably replaced by metallic filament lamps.

The Lighting of Steamships (*Elec. Magazine*, April).

Fortschritte auf dem Gebiete der Elektrotechnik: (1) Glühlampen, (2) Bogenlampen, (3) Quecksilberlampen (*Elek. u. Masch.*, April 11, 16).

An interesting summary of recent patents relating to glowlamps, arc lamps and mercury lamps. Some of these promise great things. For instance one firm describes methods of manufacturing tungsten metallic filaments said to be capable of running at 0.5 watts per H. K. without sensible diminution in candle power, and without enclosure in a vacuum being necessary. The filaments are also claimed to have exceptionally high specific resistance.

GAS, OIL, ACETYLENE LIGHTING, ETC.

Notes on Incandescent Gas Lighting, by Dr. C. R. Bohm (*The Illum. Eng., Lond.,* April).

The present instalment of this article deals with the cotton and ramie types of incandescent mantles; some general particulars are also given of the output and condition of the mantle-industry in Germany.

Street Lighting, by H. Dodimead (*G. W.,* March 27; *J. G. L.,* March 23).

The author gives his practical experience of street lighting in Great Britain, extending over many years. He gives much practical advice and information, laying stress upon the necessity of proper care in the maintenance of lamps and the design of lanterns in order to secure the best results.

EDITORIALS.

The Measure of Satisfactory Lighting (*G. W.,* April 3).

A Calorific Power Standard (*J. G. L.,* April 6, March 30).

The Refomation of the Street Lamp (*J. G. L.,* April 20).

Über Gasdrück - Ferzündungen für Strasslaternen, by Meyer (*J. f. G.,* April 17).

Elektrische Gasfernzünder, by Wendt (*J. f. G.,* April 24).

Two articles treating pressure-raising and electrical methods of automatically controlling gas lights at a distance respectively.

The article by Meyer is exceptionally complete. He gives a series of conditions with which automatic devices depending on waves of pressure in the gas mains ought to comply, and describes a number of the chief types of apparatus of this kind, including the Bamag and the Rostin, the action of which he illustrates by charts of the actual pressure required.

The second and shorter article deals exclusively with electrical methods of ignition, and is also worthy of study.

The Adoption of a Calorific Tests by the Gas, Light & Coke Co. (*G. W.,* March 27, April 3).

One event of considerable interest to the gas industry during the past month has been the adoption of a calorific tests of 125 calories per cubic foot by the Gas, Light & Coke Co., coupled with a reduction in illuminating power from 16 to 14 candles. This is an illustration of the trend toward the complete replacement of the illuminating values of a gas by calorific value, which many gas engineers anticipate eventually taking place.

The High Pressure Inverted Gas Lamps in Fleet Street (*G. W., J. G. L.,* April 6).

Demonstration Work by Gas Companies (*J. G. L.,* April 20).

Neue Invertbrenner (*Z. f. B.,* March 30).

Luftgas und Acetylen (*Z. f. B.,* April 20).

Contractions used.
Elek. Anz. **Elektrotechnischer Anzeiger.**
Elek. u. Masch. **Elektrotechnik und Maschinenbau.**
E. T. Z. **Elektrotechnischer Zeitschrift.**
Illum. Eng. Lond. **Illuminating Engineer of London.**
G. W. *Gas World.*
J. G. L. *Journal of Gaslighting.*
J. f. G. **Journal für Gasbeleuchtung und Wasserversorgung.**
Z. f. B. **Zeitschrift für Beleuchtungswesen.**

The
Illuminating Engineer

Vol. IV JUNE, 1909 No. 4

PRO BONO PUBLICO

> *"And he gave it for his opinion, that whoever could make two ears of corn, or two blades of grass, to grow upon a spot of ground where only one grew before, would deserve better of mankind, and do more essential service to his country, than the whole race of politicians put together."*—SWIFT.

Only the truth lasts. The principle contained in Swift's statement is not only true, as its frequent quotation proves, but is almost as comprehensive as the law of evolution. Stripped of its rhetorical dress, it means that whoever adds something practical for the use of mankind is not only a public benefactor, but of more vital consequence to society than mere theorizers, or those who gain only by taking from others.

Free your mind from all prejudice and preconceived notions for a moment, and consider whether a lighting company does not come strictly and clearly within the meaning of the principle set forth in Swift's familiar phrase. The very technical name of the foundation of a lighting company's business shows that its work is creative: trace gas or electricity to its source, and you find a *generator*. The billion dollars of capital invested in the lighting industry is all used for the purpose of creating something which did not exist before, and which is absolutely essential to the comfort, and intimately connected with the pleasure of the American people.

Light was never so abundant nor so cheap as at the present time, and there is not the slightest doubt that it will be used in much greater abundance and be had at still less cost in the future; and this has been brought about, not by the theories of philanthropists, nor the agitation of politicians, but by the unremitting and arduous labors of those conducting the business of producing illuminants. To paraphrase Swift: We give it for your opinion that the corporation or individual that can put up two street lamps where only one was used before, or who can give the citizen the same amount of light in his house for half of what he previously paid, deserves better of the public, and does more essential service to his city or town, than the whole race of political agitators put together.

A lighting company is a positive force for public good. Its constant purpose is to see that the public have more and better light; and more and better light means more comfort and greater happiness for the people. As a lighting company is legally a semi-public institution, so the half interest which citizens possess should be shown by hearty co-operation and encouragement. Let every public spirited citizen hold up the hands of his lighting company,—not seek to hold up the company.

LET THERE BE MORE LIGHT.

E. L. Elliott.

The City Beautiful

By Charles L. Eshleman.

"The City Beautiful" and the "City de Luxe" are synonymous.

The installation of a properly designed ornamental lighting system is one of the most important factors entering into the general decorative scheme of the modern city beautiful—important on account of its appearance during the day and doubly important on account of both utility and appearance at night. Until recent years the tendency has been to select units that would give light, with little regard to illumination (diffusion, distribution, etc.), and with less regard to the design of supporting columns. To-day, however, as much importance attaches to the selection of artistic columns and supports as to the lighting unit itself, a condition which makes it necessary that every successful illuminating engineer have at least a working knowledge of the different architectural orders.

The designs in use throughout the United States are as numerous as they are varied, every one representing the conception of some engineer, architect or civic association. Some of these installations might not appeal to our artistic temperament, yet we refrain from criticising because they meet the requirements for which they were designed and evidently please the persons who were responsible for their erection.

The writer has recently had the pleasure of taking an extended trip throughout the United States and Canada, to study different ornamental lighting installations in use in the larger cities. I am extremely sorry that space will not permit my showing photographic reproductions of the

many interesting and novel methods of street illumination employed in different sections of the country. Attention might be called, however, to the A, B, C's of ornamental lighting—the three systems now in most general use.

(A) ARC LAMPS—SUSPENDED FROM SHEPHERD'S CROOK POLES.
(B) BOULEVARD LIGHTING SYSTEM—THE DANIELS.
(C) CLUSTERS—INCANDESCENT.

ARC LAMPS SUSPENDED FROM SHEPHERD'S CROOK POLES.

Coincident with the adoption of underground electrical service, in the business districts of our larger cities, was the substitution of sidewalk lamps suspended from "goose neck" poles for the unsightly center street suspensions. The supporting poles, constructed principally of cast iron, are made in heights ranging from 20 feet to 35 feet. At or near the top the pole is fitted with either an arm or crook (of more or less ornamental design), from which an enclosed arc lamp was suspended. In some cases double arms and double rows of lamps were used. Many of these poles are massive, well proportioned and of handsome design, but unfortunately in many cases the source of light is insignificant compared with the size and height of the posts, and the effect by day is inharmonious and inartistic.

The lighting system in Cleveland is probably the most complete and, in many respects, the most representative installation of this system in the United States.

Both sides of Superior avenue are lined with poles spaced 120 feet apart, each carrying two inclosed arc lamps fitted with opalescent globes. The poles on Euclid and Prospect avenues are spaced 60 feet apart, each carrying one arc lamp.

THE DANIELS BOULEVARD LIGHTING SYSTEM.

This system was designed and patented by Mr. Walter E. Daniels, operating engineer of the Chicago South Park Commission, in connection with extensive park, boulevard and business district lighting improvements in that city. The idea is a radical departure from generally accepted standards of ornamental lighting and possesses real merit. The inventor has adhered strictly to classical designs, and throughout the development of the system he has maintained a well balanced relation between utility and art. Each unit consists of a classical column and capital surmounted by a complete arc

TUNGSTEN CLUSTER LIGHTING, THIRD AVENUE, SEATTLE.

lamp mechanism, inclosed with a 20-inch opal ball globe. On account of the high intrinsic brilliancy of the light source the 20-inch sphere is thoroughly filled with light. The large opalescent globe insures freedom from shadows, eliminates the glare of the arc, and produces a well diffused and equal distribution of light. It might be mentioned in passing that the foot-candle intensity of illumination is approximately the same at the base of the column as at different surrounding zones represented by distances of 10, 20, 30, 40, up to 50 feet from the light source. It is obvious, therefore, that units spaced 100 feet apart will insure uniform illumination. The units are designed for series as well as multiple circuits, and can be supported by columns constructed of reinforced concrete, pressed steel, pressed copper, bronze or cast iron.

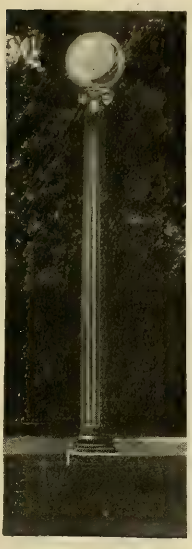
INCANDESCENT CLUSTERS.

As the name signifies, the incandescent cluster consists of a metal supporting column, surmounted by a number of arms carrying incandescent lamps inclosed within opalescent globes. The cluster has been in vogue for a number of years, but it remained for the tungsten lamp to stimulate the growth and popularity of the system. On account of flexibility of construction, the cluster unit has offered the engineer and architect an unlimited field for carrying out different ideas in design. This condition is reflected in the fact that a person seldom sees two installations alike. A number of Pacific Coast cities afford the best examples of cluster lighting.

ORNAMENTAL LIGHTING IN WESTERN CITIES.

With few exceptions, Western cities, especially Pacific Coast points, have installed ornamental street lighting systems that eclipse those used in Eastern cities. There are good reasons for this condition. The cities are growing rapidly and many have just reached a point where under-

ORNAMENTAL LIGHTING, CLINTON, IOWA.

A STUDY IN ORNAMENTAL LIGHTING COLUMNS. 1.—CLEVELAND—CAST IRON. 2.—TACOMA—CONCRETE. 3.—CHICAGO—CAST IRON. 4.—CANTON—PRESSED COPPER, ANTIQUED.

ground service is being installed. These cities have been able to avail themselves of the most modern systems of ornamental lighting, whereas in the larger Eastern cities, where underground distribution has been available during the past ten to twenty years, we find an assortment of ornamental lighting units representing developments extending over a considerable period of time.

SOUTH PARK, CHICAGO.

The impulse for civic improvement seems stronger in the Western cities on account of keen rivalry existing between them. Each city tries to outdo its neighbor. Armed with a catchy slogan—"Watch Tacoma Grow," "Send Your Wife to Prosser," "Yakima Is Better," etc.—the citizens, through their Board of Trade, set about to abolish signboards, remove overhead wires and establish an ornamental lighting installation. And so they go, hand in hand—the City Beautiful, the City de Luxe, and the slogan.

St. Louis.—All three systems of ornamental lighting can be seen in St. Louis—shepherd's crook, Daniels' boulevard, and tungsten cluster. All designs correspond so closely to the general description already given that it will be useless to enter into a detailed study of them.

Kansas City stands in a class by itself, as far as ornamental lighting is concerned. Whether or not it is an enviable position is more or less a matter of opinion. Personally, I would say that it is the most homely installation that I have seen in ten thousand miles' travel. Undoubtedly

BANKS OF THE MISSISSIPPI, CLINTON, IOWA.

the present method of lighting is a makeshift and will shortly give way to a more comprehensive layout and more artistic designs. A curved arm bolted to sidewalk trolley poles carries at its outer end a metal reflector and a high candle-power tungsten lamp. This in itself might not be criticised, but immediately above the reflector a 6-inch opalescent globe incloses a 16 candle power incandescent lamp. It is a double deck arrangement and is suggestive of an inverted cuspidor.

Omaha has not yet adopted an extensive underground system of electrical distribution, consequently has not been in position to consider an extensive ornamental lighting system. It is a beautiful city and is ideally laid out. The citizens are up to date, wideawake, progressive, and it goes without saying that she will be the proud possessor of a modern system of ornamental lighting before many years.

Denver says "How do you do" and "Good-by" to every traveler who enters and leaves her gates. Emerging from the Union Depot, you are greeted by "Welcome" outlined by electric lights and supported by a large arch in the plaza fronting the station. Leaving the city, you are confronted by the other side of the sign, bearing the word "Mizpah" (May God watch between me and thee while we are absent one from another). Although this sign is no respecter of persons—extending the same welcome to the Pullman and freight car passenger—the sentiment expressed is appreciated by every one and the psychological effect upon the stranger is stronger than one at first thought might imagine.

The business section of the city is well lighted and the units themselves present a good appearance, both by day and night. As is often the case, local conditions play

BOULEVARD LIGHTING.

an important part in the design of an ornamental lighting system. In this case it seemed advisable to design a column that would serve as a support for the trolley wires and also to carry the lighting units. Walking along Sixteenth avenue by day a person will note that each of these poles carries two arms, one extending over the street and the other over the sidewalk. An inclosed arc lamp fitted with opalescent globes is suspended from each arm. At night, however, you are surprised to see only one line of lights burning, those on the arm projecting into the street. In conversation with Mr. Henry W. Read (artist, architect and a man who has done much toward beautifying Denver) this rather odd condition was mentioned, and he explained to the writer that both lamps were used so that each unit would have perfect balance by day, and that only one was burned at night because the effect obtained from a single line of lights is better than from a double line. This reasoning did not appeal to me so strongly at the time, but since then I have had occasion to study this condition in a number of installations and am thoroughly convinced that a single line of units down each side of a street is more effective, has more individuality and stands out to better advantage than a double line, or a conglomeration of smaller units. This comparison can well be made in Cleveland, and almost every one agrees that Euclid Avenue, with a single line of lights on each sidewalk, is more effective than Superior Avenue with a double row.

Salt Lake City is among the last of the Western cities to give serious consideration to an ornamental lighting installation.

Los Angeles was the first city in the United States to adopt cluster lighting and to-day has the largest installation of the kind in the world. The columns and arms are made of cast iron, each arm carrying a number of carbon filament incandescent lamps inclosed within opalescent globes. Experiments have recently been carried out with a view of replacing the carbon filament lamp with tungsten lamps. The current consumption can be reduced, more light can be obtained and the system will undoubtedly be more satisfactory than heretofore.

The streets of Oakland are at present lighted by approximately 400 clusters, fitted with carbon filament incandescent lamps. Each post supports two arms and three globes. The large central globe is supported on the extreme top of the post and incloses four 16 candle power incandescent lamps. The other globes inclose three each, making a total of ten 16 candle power incandescent lamps per unit. The current consumption is 600 watts per unit with only 160 candle power. This condition is extremely unsatisfactory, and even though posts are only 40 feet apart, the streets and sidewalks are not well lighted.

On account of extensive building operations carried on since the fire of three years ago San Francisco has not completed all street paving and sidewalk laying, consequently has not installed a general system of ornamental lighting. A temporary installation of arc lamps suspended from cast iron poles is now in operation on Market Street. Specially designed tungsten clusters and Daniels boulevard lamps are in operation in other sections of the city.

Several avenues in Seattle are lighted by five-light tungsten clusters, similar in design to those shown in accompanying illustration. The Fourth Avenue Improvement Club has adopted the Daniels boulevard lighting system.

Tacoma has also adopted the Daniels boulevard lighting system, and within a year will have between 300 and 400 series A. C. units in operation.

To fully appreciate the efforts now being exerted throughout the world to produce a fair cityhood, we must compare the city of several centuries ago with the present-day metropolis. In going back through the ages, it is manifestly evident that a certain amount of civic pride existed; but we are led to believe that municipal improvements were made rather from necessity than choice, and rather from the demands of public safety, comfort or health than from an appreciation of the æsthetic. As an example, street and park lighting were originally classed as merely incidental to police service as a means of public safety. This conception has been entirely eclipsed by the efforts

now being made to employ electric lighting as a decorative and artistic factor in the production of the nightless day. The city beautiful is no longer a dream, a mere aspiration of the idealist, but an accomplished fact, largely because of the great growth of the national impulse for civic improvement.

Some Notes on the Historical Development of Street Lighting in London in the Seventeenth and Eighteenth Centuries

(Concluded.)

By a Correspondent.

II.

Some still removed place will fit,
Where glowing embers through the room
Teach light to counterfeit a gloom;
Far from all resort of mirth,
Save the cricket on the hearth:
Or the bellman's drowsy charm,
To bless the doors from nightly harm.
Milton's "Il Penseroso."

We can hardly imagine the condition of things in the time when, by statute of Edward I., it was ordered "that none be so hardy as to be found going or wandering about the streets of the city after curfew tolled at St. Martin's-le-Grand, with sword or buckler, or other arms for doing mischief, or whereof evil suspicion might arrive, nor in any other manner, unless he be a great man, or other lawful person of good repute, or their certain messengers, having their warrants to go from one to another, with lanthorn in hand"; or when still in 1704, by act of the Common Council, it was provided "that for the small precinct of Blackfriars 6 men were ordered to patrol the street all night, and that for Monkwell Street alone two men were to walk up and down all night."

At this date there were no lights at all in extensive districts in London, and in the others the few lanterns glimmered feebly before only one house in ten, and

during but a small part of one night in three. We need not wonder that crimes were of such ordinary occurrence that the Lord Mayor and Aldermen in 1744 presented an address to the king, representing "that divers confederacies of great numbers of evil-disposed persons, armed with bludgeons, pistols, cutlasses, and other dangerous weapons, infest not only the private lanes and passages, but likewise the public streets and places of public concourse, and commit most daring outrages upon the persons of your Majesty's good subjects, whose affairs oblige them to pass through the streets, by terrifying, robbing, and wounding them; and these facts are frequently perpetrated at such times as were heretofore deemed hours of security."

In the time of Charles II. Dryden was waylaid by a gang of swaggering bullies and hired ruffians; and in 1712 we hear of the Mohocks, another gang of young fellows from the upper ten, who used to amuse themselves with "games" called "tipping the lion," *i. e.,* to squeeze the nose of their victim flat upon his face, and to bore out his eyes with their fingers (*vide* Lecky's "History of England in the Eighteenth Century"; quotation from Swift's "Journal to Stella"; Gay's "Trivia"; *The Spectator,* 327, 335, 347). Other clubs were the Muns and Tityre, Tus, the Hectors, the Scourers, the Nickers, the Hawcubites. The Sweaters—and other bands of fashionable noblemen—used to form a circle round their prisoner and prick him with their swords till he sank exhausted to the ground. Another club was that of the Dancing Masters, so called from their skill in making men caper by thrusting swords into their legs.

Even in 1780, in a letter of June 7, Richard Burke wrote: "This is the fourth day that the metropolis of England is possessed by an enraged, furious, and numerous enemy. Their outrages are beyond description, and meet with no resistance." Most of the crimes—I dare say 75 per cent. of them—were committed in the night, and the ill-lit and ill-guarded streets constituted one of the chief causes. The Government was weak and the police powerless. The magistrates dared not call out the Guards for fear of being hung, and the Guards used not to come for fear of being given up to the blind rage of popular juries.

"Officers of justice," wrote Sir John Fielding ("Causes of the Increase of Robbers"), "have owned to me that they have passed by such with warrants in their pockets against them, without daring to apprehend them, and indeed they could not be blamed for not exposing themselves to sure destruction, for it is a melancholy truth that at this very day a rogue no sooner gives the alarm within certain purlieus than twenty or thirty armed villains are found ready to come to his assistance."

Although in compliance with ancient customs (*vide* my first article), it was enacted by the Statute 2 William, Mar. i. 8 (superseded 1736 by 9 Geo. II. c. 20), "that housekeepers in the City of London and within the bills of mortality, whose houses adjoin to the streets, should hang out lamps from the time it grew dark till 12 o'clock at night from Michaelmas to Lady Day, or pay for lamps, under the penalty of 2 shillings for every default," &c., yet dark streets were infested by gangs of thieves and robbers, till proper lighting of them put an end to their pillage forever.

The progress of industry had rendered it necessary that "others besides great men and their accredited messengers should go about a night."

Moreover, the population was increasing. There was the greatest difficulty in maintaining any effective industrial and social order in such a rapidly increasing center of population, and the machinery of municipal institutions proved insufficient to grapple with the situation. From about the middle of the eighteenth century onwards, an almost continuous stream of special Acts of Parliament conferred new powers of regulation, collective provisions, and taxation which enabled the town to cope with the difficulty with greater success. These new powers were conferred upon the Corporation itself,* and exercised by its governing council or by bodies of commissioners appointed and controlled by it, or to new bodies, established for the special pur-

* For most of the following records I am indebted to the excellent work of B. and S. Webb, "English Local Government."

poses desired, "ad hoc" authorities, i. e., new statutory authorities created for the purpose, among other things, of considering the lighting of the streets of London.

We must bear in mind the fact that the administrators of the city had originally in mind only the suppression of nuisances. To this fundamental function were added such services as the lighting of the streets. We must also recollect that lighting as well as paving and cleansing and all other local needs were regarded as *personal* responsibilities, and the function of the municipal corporations in these directions had been confined, for the most part, to *enforcing* obligations on householders.

We have to go back to the Act of 1585 (Burleigh's Constitution) to the Court of Burgesses (consisting of twelve unpaid Westminster tradesmen and twelve others as Assistant Burgesses), who made "Order and Ordinances," and had to hear, examine, and punish according to the laws of the realm. Every Westminster shopkeeper, for instance, was intended to keep a constant supervision over his neighbors and report on any neglect of the householders' obligation to light the street opposite his frontage.

At the beginning of the eighteenth century ward organizations enforced upon the householders onerous obligations of personal services. It was the ward inquest, on its periodical round, which threatened the householder with the law for omitting to hang out a lantern with a lighted candle on the nights when there was no moon, as directed by Act of Common Council of 1716. But as soon as these personal services were undertaken by contractors, and carried out by hirelings, at the expense of funds collected from the ward in rates, a more responsible executive organ for the assessment and collection of the rates and the control of the administration was formed, namely, the Common Council of the Ward. Nevertheless we must not forget the fact that the lighting of the city streets was far superior to what was done elsewhere, and that it was done by the constant pressure of the inquest juries. The Inquest of Vintry Ward even prosecuted the Lord Mayor, Aldermen and Commonalty—the City Corporation itself [*sic*]—for neglecting to light a certain "common house of easement," which they had to maintain (*vide* MS. Records, Vintry Ward, 1696).

The Inquest Jury was superseded by the Common Council of Ward, and the lighting of the narrow streets passed as an *organized* service into the hands of the Common Council of the Ward. By statute of 1736, Parliament empowered the Aldermen, Deputy, and Common Councilmen of each ward, to contract for the lighting of the ward, and to levy a rate for the purpose (9 George II. c. 20, 1736; 'Journals of the Court of Common Council,' Oct. 22nd, 1735, July 8th, 1736, and Sept. 17th, 1736; amended by 17 George II. c. 29, 1744; Journals of the Court of Common Council, Oct. 16th, 1744, vol. lviii. p. 338).

The business of lighting came at last into the hands of the Commissioners of Sewers, a body established by Local Acts of 1667, 1672 and 1771, for many years only a committee for elaborating and supervising the obligations of the householders (*vide* Fitzherbert, 'Natura Brevium' 113). The Commissioners of Sewers were subsequently invested (*vide* 11 George III. c. 29, explained and amended by 33 George III. c. 75, and 4 George IV. c. cxiv.) "with the whole power of lighting the several streets, lanes, squares, yards, courts, alleys, passages, and places within the said city and liberties. For the better lighting of the said streets, etc., the Commissioners are authorized to cause such and so many lamps to be set up in such places within the said city and liberties, and to be placed in such manner and at such distances as they judge necessary; and to order and direct at what time the lamps shall be lighted, and how long they shall continue lighted, and from time to time to give such orders and directions as they think needful" (*vide* C. Welch, 'Modern History of the City of London').

As mere curiosities I may add to these notes two further records dating from the seventeenth and eighteenth centuries.

The first relates to 1691, when the Lord Mayor was by the Court of Aldermen "desired to issue forth his precepts to the Aldermen of the several wards . . . to require every inhabitant within their

respective wards to hang out their lights according to ancient customs, and to take especial care that the ward and parish lights be duly hung out" ('Repertories,' vol. xcv. Oct. 6th, 1691).

The second dates from 1737-1738, when the Court of Burgesses contemplated getting powers to put up lamps to light the streets, the vestries protesting that this service "should be parochial and not general" (MS. Vestry Minutes, St. Martin's-in-the-Fields).

THE NEW LIGHTING ON ATLANTIC AVENUE.

Public Lighting in Atlantic City

By L. W. Byers.

In the May issue of The Illuminating Engineer a year ago the writer described the proposed improvements in the public lighting system of Atlantic City. These proposed improvements have now become, to a considerable extent, accomplished facts; and it may interest your readers to compare the realization with the contemplation. As was set forth in the previous article, the lamp posts are of two distinct types, one used at the corners of streets and the other between the street intersections.

Fig. 1 is a night view of Atlantic Avenue, showing the complete installation in use. As will be seen, the illumination is brilliant. The lamps at the two different heights show a double row of lights down either side of the street, which adds to the general effect of brilliancy. The ornamental trolley poles in the centre of the street are also worthy of note.

Fig. 2 shows two of the corner posts as erected. They support an arc lamp at the top, and two lanterns for incandescent lamps at one-third of the height of the arc, and also street signs, as well as police and fire department boxes.

The smaller post shown in Fig. 3 is a simple lantern containing incandescent electric lamps supported by a plain column and base.

Fig. 4 is another view of Atlantic Avenue, showing the outline lighting and illuminated clock dial on the City Hall.

Fig. 5 shows another section of Atlantic Avenue, with one of the larger posts in the immediate foreground. The illumi-

FIG. 2.—ARC LAMP STANDARD.

FIG. 3.—INCANDESCENT LAMP STANDARD.

FIG. 4.—ATLANTIC AVENUE, SHOWING ILLUMINATION ON CITY HALL.

FIG. 5.—ATLANTIC AVENUE, SHOWING ONE OF THE LARGER STANDARDS IN THE FOREGROUND.

FIG. 6.—BOARDWALK AT TENNESSEE AVENUE.

FIG. 7.—BOARDWALK AT NORTH CAROLINA AVENUE.

FIG. 8.—AN ELECTRIC WATERFALL.

nated street sign, the lower lanterns, and the arc lamp all showing a brilliant light. As in all cases, however, the details of the post itself are practically lost in shadow, and by contrast with the intense light of the electric lamp.

As those who are familiar with this city know, Atlantic Avenue is the principal business thoroughfare, and runs parallel to the famous boardwalk, extending from end to end of the island on which the city is situated. It is a broad avenue, with double car tracks in the centre, on which are located the most important business buildings.

No one would think of visiting Atlantic City without taking a stroll on the boardwalk, so perhaps the reader would not be satisfied with a description of the city's lighting without having a glimpse of this famous promenade.

Fig. 6 is a typical view, showing the festoons of incandescent lamps over the walk and along the sides. The electric signs are quite as much of a feature as the regular lighting, some of the largest and finest displays of this kind in the world being located here.

Fig. 7 shows one of the newer signs, whose size can be judged by comparison with the buildings. Perhaps the most striking sign along the whole walk is that shown in Fig. 8. By the well-known flashing arrangement what appears to be simply lines of light in the centre of the photograph produce the appearance of falling water. Forming a background for this is a painted scene, which is only dimly shown in the picture, but which can be plainly seen by the illumination of the lamps, and which adds greatly to the realism of the effect. Fig. 9 is an attractive sign in colors.

The very substantial and artistic appearance of the lamp posts by day, and the brilliant street illumination by night have fairly created a new avenue, and when the entire system as described a year ago is completed, Atlantic City may justly claim a place among the best lighted municipalities in the country.

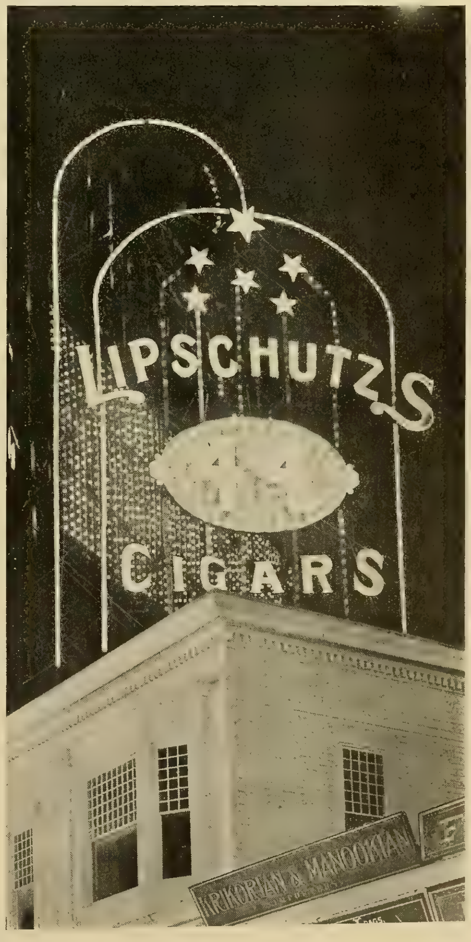


FIG. 9.—AN ELECTRIC SKYROCKET.

Modern Street Illumination by Metallic Flame (Luminous) Arc Lamps

By G. Brewer Griffin.

There seems to be certain periods in the history of street lighting when the type of lamp undergoes a very considerable change, owing primarily to advances in the art of illumination which is not always confined to developments in electric lines.

The recent development in tungsten incandescent lamps and gas mantles of high luminosity has made it necessary for the arc lamp designers to revamp their output to produce something which will still maintain the same general relations between the arc lamp and other forms of illuminating devices which have heretofore existed. Thus the arc lamp consuming metallic oxides which are combined with suitable fluxing substances has entered the market, and is rapidly shouldering out forms of inclosed carbon lamps which yesterday were considered the acme of mechanical and electrical excellence. These periods seem to be about every ten years.

THE SALE AND USE OF LIGHT.

The central station sells energy to produce light. The consumer, whether a municipality or a private individual, purchases light and pays for energy. Therefore, broadly, the most light delivered for the least energy consumed is an advantage for both parties when a simple analysis of the situation is made. In the case of a consumer, the benefit is so obvious that nothing more need be said. In the case of the central station, the benefit accrues by a largely increased number of consumers and more popular conception of the advantages of electric light with the other varied uses of electric current which is supplied to the consumer through his meter or otherwise.

In the case of the supply of light to a municipality by a central station, it comes down to a question of the ability of the central station to give a satisfactory light at a competitive price. Broadly, the municipality is not interested in the question of arc wattage or the terminal wattage if it bears no relation to the amount of light given off by the lamp. Therefore most municipalities are intent upon getting the latest form of lamp which has the greatest light giving qualities and diffuses its light in the most useful directions. If such a lamp would take more energy than the old forms of lamps, then the central station is only willing to supply it at an advance in price over the previous arrangement, which is natural; but, on the other hand, the lamp taking less energy to produce the same or a greater volume of light, it would seem on the first glance only fair that the central station give the municipality the benefit of the decreased current consumption; but, on further analysis, it would seem that if new developments continue to occur in ten-year periods, then the total cost of the arc lighting equipment must be charged off within ten years, and preferably within seven years, in order that the maintenance charges of the system can properly be figured in with the initial cost.

The writer believes the present tendency of municipalities or their agents is to purchase light in preference to current through a meter. In other words, if a given lamp produces 1,000 candle-power with 1,000 watts and another lamp produces 1,200 candle-power with 750 watts (these figures simply being given as illustrations), then the municipality would prefer the second lamp at the same price.

In this article it may be well to touch briefly on the more important characteristics of the several types of lamps, such as the open arc, inclosed arc and metallic flame arc, as without doubt the reader will be most generally interested in the comparison of the lamps by types to bring out the merits of the various lamps.

We must start first with the proposition that the modern method of comparing arc lamps is on the mean hemispherical candle power reading with distribution curve, instead of the obsolete practice of on the mean lower hemispherical candle power

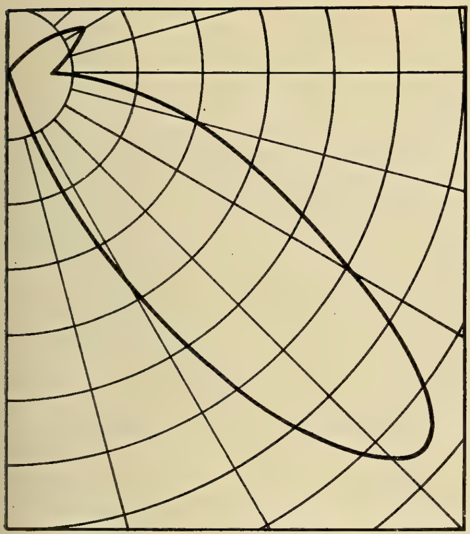


FIG. I.—TYPICAL LIGHT DISTRIBUTION CURVE OF A D. C. OPEN ARC.

basis. The present method is the right one, as arc lamps are used generally for illuminating large areas, and in order that a proper calculation may be made in advance for the amount of surface illumination to be received the shape of the light distribution curve must be known in advance.

There are various conditions which affect the shape of a light distribution curve, such as diameter, position and quality of carbon and position and dimension of the supporting side rods.

Fig. 1 gives the typical light distribution curve for a direct current open arc lamp. It will be observed that the maximum light is given at an angle of approximately 45 degrees below the horizontal, with very little above the horizontal, and, further, that the larger portion of the light is emitted from the incandescent crater of the positive carbon. Now in this form of lamp, the arc being short and the position of the carbons as they are, approximately 30 per cent. of the available light of the positive crater is intercepted by the negative carbon and is therefore lost so far as useful illumination is concerned. The light from the arc itself between pure carbons is of comparatively low intensity.

Now let us compare this curve with the distribution curve in Fig. 2, which shows the typical distribution curve of the alternating current open arc.

It will be noted that the light distribution is approximately the same above and below the horizontal. In this lamp the light radiating above the horizontal is useless for all practical purposes unless suitable reflectors are used to divert it downward, but it is impractical, if not impossible, to design a reflector which will operate at a maximum efficiency at all positions of the arc throughout the life of the trim, and, in addition to this, there is always a loss of light by reflection, the percentage of which depends upon the material used in the construction of the reflector. On account of this difficulty it would appear that so far as lighting results are concerned, independent of other considerations, the direct current arc is much more suitable for general use.

In an effort made by arc lamp designers and experimenters to improve upon the

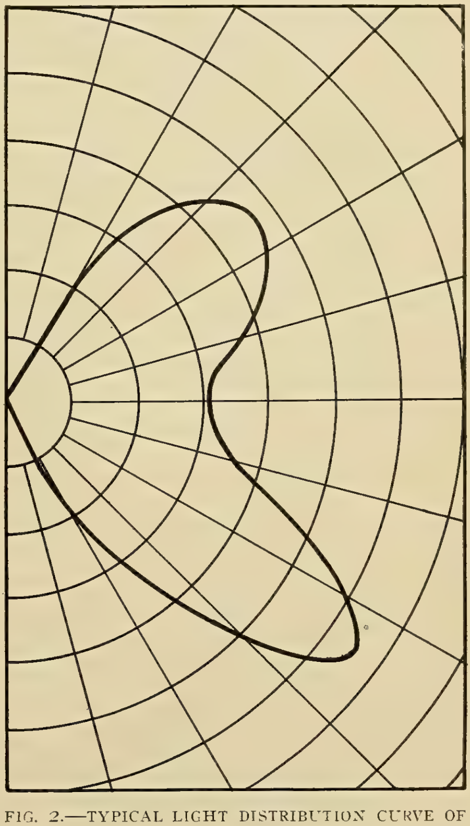


FIG. 2.—TYPICAL LIGHT DISTRIBUTION CURVE OF AN A. C. OPEN ARC.

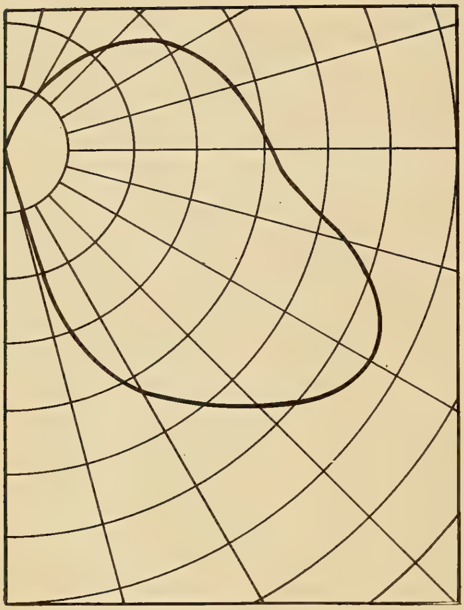


FIG. 3.—TYPICAL DISTRIBUTION CURVE OF A D. C. INCLOSED ARC WITH OPAL MMS. GLOBE.

preceding forms of lamps, there was developed a so-called "carbon flame lamp," which has now become well known and modifications have been made by other manufacturers. In this lamp the arc is maintained on the tips of carbons, said carbons being inclined towards each other and blown down by a magnetic field so as to give a long flaming effect. This was some improvement over open and closed arcs of the vertical carbon types, as the positive carbon crater and the brilliant white tip of the negative carbon are exposed, improving the shape of the distribution curve, which, however, is very similar to but not as good as the chemically prepared "flaming carbon arc lamps" which were later brought out by Bremer, but both lamps are limited in application to a fair field of work. It will be observed that a considerable amount of energy is wasted, as the long flame arc is nonluminous.

We now come to the development of the carbons which made the inclosed carbon arc lamp possible. This step forward resulted in greater operating economy, as the labor in trimming and caring for the lamps was considerably decreased.

A typical light distribution curve of the direct current inclosed carbon lamp is given in Fig. 3. Carbons burning in partial vacuum, such as the inner bulb gives, burn flat on the ends, giving comparatively large areas, so that the crater can occupy only a small portion of the total area at any particular instant. The distribution curve is irregular on this account, as the amount of light in a given direction varies with the position of the crater or carbon end. This curve is somewhat improved by the use of an opalescent diffusing globe, which gives the effect of a steadier point of source, but decreases the intrinsic brilliancy of the arc.

Fig. 4 gives a typical light distribution curve of the later type of the so-called "flaming carbon arc lamp," or, in other words, an arc lamp which has mixed with the carbons used certain metallic salts and compounds of calcium, the carbons working at an angle. The light efficiency of this type of lamp depends upon the high temperature of the arc, which produces the luminescent vapor. Lamps of this type have considerable by-product deposits, chemical fumes, etc., to dispose of which necessitate the arc operating in an open position—that is, without inner bulbs. As before stated, this lamp depends for the high efficiency of the arc on its high temperature and this means a rapid consumption of carbon, so that life per trim is sacrificed to light efficiency.

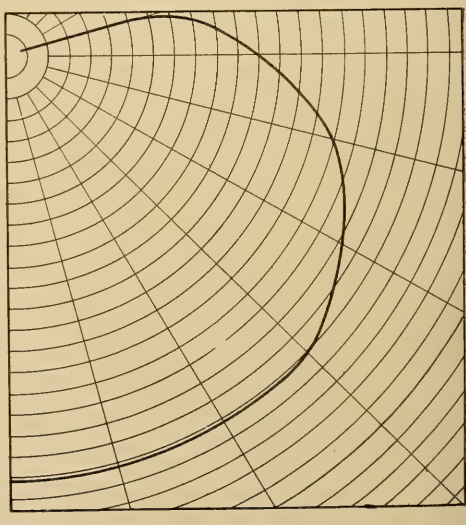


FIG. 4.—TYPICAL DISTRIBUTION CURVE OF A FLAME CARBON ARC.

The color of the light of these lamps is determined by the nature of the salts and can be controlled through a considerable range, but it is found that the efficiency of the arc varies in a percentage depending upon the character of the impregnating salts used. The most efficient lamps the writer knows of emit a yellow light, and as yet an impregnated carbon has not been produced which will give a white light except at considerably reduced efficiencies.

A few words might be said here in regard to the improvements in efficiencies which have been made in the past few years. For example: The direct current open arc consuming 450 watts consumes practically 1.25 watts per mean spherical candle power; the direct current inclosed arc consuming 400 watts takes approximately 1.75 watts per mean spherical candle power, and the direct current flame carbon lamps, producing a yellow light, consuming 450 watts at the arc, takes approximately 0.3 watt per mean spherical candle power. These encouraging results have led to a considerable further study in recent years and brought about the development of metallic flame arc lamps—namely, lamps using metallic substances in place of carbons. The efficiency of this type of lamp is obtained by using for electrodes materials which when volatilized give an intensely luminous flame. It is found that a white light is preferable, as it best meets the public demand.

(To be continued.)

Street Arc Lighting

By G. H. Stickney.

The practice of illuminating the surface of the street dates from the adoption of arc lamps, about 1878. Previous to this time street lighting ordinarily implied the use of lamps to indicate the course of a street without any real illumination of the surface being attempted.

The primary purpose of street lighting is, of course, to insure safety to travelers and the intensity required depends on the density of traffic. Where the travel is infrequent the occasional light as a beacon is usually the best that can be afforded and serves fairly well. But where traffic is denser it is necessary to provide sufficient illumination that one may see clearly and quickly in order to avoid collisions. Conversely since good illumination favors travel, traffic increases when suitable illumination is provided. These two factors working reactively keep increasing the demand for higher intensities. Beyond the actual requirements of safety, the merchants of a street frequently find it profitable to provide special illumination, at a considerable expense, to attract people to the street.

An ideal street illumination would be one in which an even intensity would be distributed well over the roadway, avoiding dense shadows and intensely glaring lamps. Any variation from even intensity should provide a relatively strong illumination at the street corners, where the intersecting lines of travel make the danger of collision greater.

In practice it is not possible to provide an absolutely even intensity, since all lamps furnish the strongest illumination nearby. In order to approximate an even effect, the lamps should emit the strongest light at the oblique angles which illuminate the spaces midway between lamps.

When a low intensity of light is to be provided, especially if the street is narrow and crooked, small units are always advantageous. Under such conditions large units would have to be spaced too far apart to be effective. When a relatively high intensity is required, especially where streets are wide and regular, large lighting units produce the best illuminating effect and avoid cluttering the street with numerous poles and fixtures. Small units, especially incandescent lamps, lend themselves particularly to special ornamental design lighting; but for the actual production of an effective illumination the series arc lamp as used for street lighting

STREET ILLUMINATION WITH MAGNETITE ARC LAMPS, COMMONWEALTH AVENUE, BOSTON.

is the most economical and satisfactory unit available.

The earliest arc lighting employed the direct current series carbon open arc, consuming about 500 watts. This was the first efficient large unit and revolutionized the street lighting practice. It was practically without competition for the better class of street lighting until 1895, when the inclosed arc lamp began to be used. In a very short time the inclosed arc lamp almost entirely superseded the open arc. While the inclosed arc was not so efficient nor so powerful as the open arc lamp, it was more reliable and distributed the light more effectively, giving a relatively stronger light in the intermediate spaces. The shadows of the lamp frame, which were objectionable with the open arc, were practically eliminated with the inclosed. The change was encouraged by the economic features of long carbon life, which reduced the labor and expense of maintenance.

The inclosed arc was developed first for series direct current circuits and then for series alternating. The advantage of the latter from the operating standpoint was that with the constant current transformers the current could be supplied from the larger station alternaters instead of requiring special arc generators.

The magnetite arc, which since 1907 has been rapidly supplanting the inclosed arc lamp, is the result of long and careful scientific research to find the most effective and efficient electrode materials. There are to-day about 30,000 of these lamps in service in eighty different cities in the United States. The magnetite arc, which burns in air as did the open carbon arc, is maintained between a positive electrode of copper and a negative electrode composed of a compound of iron oxide and titanium. It is suitable only for direct current, which with the recent developments can be furnished from the large station alternaters, being transformed and rectified by the constant current transformers and mercury arc rectifier. Only the negative electrode is replaced in trimming the lamp. The positive electrode lasts for two years or more. The magnetite arc is more efficient than the open carbon arc, has the

long burning principle of the inclosed arc and distributes its light more effectively than either.

The candle power rating of arc lamps has been the cause of much misunderstanding. In the first place, since the candle power varies considerably for different angles of elevation, it is quite necessary in designating the candle power to specify the angle. Frequently the mean spherical or mean (lower) hemispherical candle power is given.

Usually in street arc lighting the light emitted at 5 degrees to 10 degrees below the horizontal is considered the most valuable, since it reaches points between lamps where the intensity is least. It is not generally desirable to have a high intensity of light immediately beneath the lamps, as the illumination at this point is likely to be too intense and render the general illumination less effective by contrast.

When the open arc lamp was first placed on the market photometric methods were very crude. As a result this lamp was considerably overrated. The so-called "2,000 candle power" lamp gave only about 1,200 candle power at 45 degrees below the horizontal, the angle of maximum intensity, while the mean spherical candle power was only about 460 and the candle power at 10 degrees below the horizontal about 500. This has been the cause of many controversies between the lighting companies and municipalities, not only in regard to the open arc, but also the inclosed arc lamps. Although the open arc gave a higher maximum candle power than the inclosed arc, taking equal power, the fact that the maximum candle power illuminated the ground within 25 or 30 feet of the lamp did not render it particularly effective for street lighting. On the other hand, the candle power of the inclosed lamps at 10 degrees below the horizontal corresponded very favorably with that of the open arc and is actually more effective for ordinary street lighting. In the case of the magnetite, even the four-ampere lamp gives a much higher candle power at 10 degrees below the horizontal than either the open or inclosed arcs.

The latest approved practice of rating the lighting value of street arc lamps is in terms of the intensity of the normal illumination at 250 feet from the lamp.

Mr. W. D'A. Ryan made a series of measurements on street arc lamps in regular service in different parts of the country, in order to determine values for rating in accordance with the scheme outlined by the Street Lighting Committee of the National Electric Light Association. Some of the values obtained and submitted in terms of the N. E. L. A. unit were as follows:

9.6 ampere D. C. series arc lamp, 4.
6.6 ampere D. C. series inc. arc lamp, 4.
7.5 ampere D. C. series inc. arc lamp, 4.
4 ampere D. C. series magnetite arc lamp, 5½.

Magnetite arc lamps and tungsten incandescent lamps can be operated in series on the same circuits. Combined they form a very attractive system of lighting, suitable for almost any conceivable street lighting conditions.

As time goes on people are paying more attention to the lighting of city thoroughfares, demanding more attractive fixtures and stronger, yet softer, lighting effects. This has been illustrated in the recent contest for the street lighting in Boston. Both the electric and gas companies sent experts to Europe to study the best street lighting practice abroad. As a result there came a demand for a larger unit than has previously been used in American street lighting.

In competition with the European press gas and flame arc lamps was placed the 6.6 ampere magnetite, differing from the standard only in the higher current and the use of opal globe.

The high current magnetite lamp, while consuming only 65 per cent. more power than the four-ampere size, develops about 150 per cent. more candle power. With this high efficiency it is advantageous to soften the light by opalescent globes. This combination has been selected by the Boston city officials after thorough and conclusive tests and observations made under regular operating conditions. The results have been gratifying to all concerned. When several thousands of these lamps are in regular use in Boston streets, Boston will be one of the best, if not the best, lighted city in the world.

ORNAMENTAL LAMP STANDARDS ERECTED BY THE MUNICIPAL ART SOCIETY, NEW YORK.

Public Lighting and Municipal Art

Public interest in the beautification of our cities has shown itself by the organization of Municipal Art Societies in many instances. It is the purpose of such organizations to co-operate with the city authorities in laying out such public utilities as are proper subjects of artistic treatment, and in educating the public in general to an appreciation of the necessity and advantages of greater efforts toward establishing "the city beautiful." The present movement for better public lighting has been frequently taken up by such societies—in some cases by offering prizes for designs of lamp-posts; in others by co-operating with city authorities.

The very handsome lamp standards shown in the accompanying illustration is one of two erected in Long Acre, now called Times, Square, New York City, by the Municipal Art Society.

Studies of Notable Installations

A Cottage by the Sea

To the southward of the island of Manhattan there is a strip of low lying country called New Jersey; and toward the southern end of this bailiwick there is a city by the sea, to which the natives have given the name Atlantic City. Here the land and sea seem loathe to part; the gently sloping sand stretches far out under the water, and the waves, after their ocean voyage of 3000 miles, spend themselves in a long roll up the reaches of glistening beach. The delights of the place were long since discovered by the inhabitants of the interior of the country, who are wont to journey thither, especially during the summer season, and enjoy the change from the soot-laden air of mill and factory to the salt sea breezes, and to

FIG. I.—MARINE COTTAGE, YOUNG'S MILLION DOLLAR PIER.

FIG. 2.—RECEPTION HALL.

FIG. 3.—DINING ROOM FROM RECEPTION HALL.

FIG. 4.

gaze at the roaring surf instead of into the pigeon-holes of a desk. In fact, so general has this custom become that about one-fifth of the entire adult population of the United States annually pay a visit to this city by the sea.

Just at the dividing line between land and water there is a foot path made of boards; and as every one who comes here wants to see the ocean, it happens that something over seven million people promenade this boardwalk every year. On account of the long reach of shallow water it is necessary to extend piers far away from the shore in order that the numerous water-craft may make a safe landing. These piers for the most part consist of wooden causeways resting under wooden piles, and extending out from the boardwalk so far that to walk to the end is almost like going to sea.

In a number of cases these piers, or platforms, have been widened and serve as foundations for buildings, some of which are of large proportions and magnificently constructed. The newest and largest pier of this description is commonly known, from the amount expended upon its construction, as the " million dollar " pier; also from its owner, " Young's Pier." About midway of this pier the owner, Captain John Young, has built for himself a cottage, to which he has given the simple, but befitting, name, " Marine Cottage "; and, lest the wayfarer loses his bearings, the Captain has placed many lamps about his cottage, so that, seen through the darkness, it has something the appearance shown by the picture. (Fig. 1.)

If you have the good fortune to be the Captain's guest you will be received amid the surroundings shown in Fig. 2. The locations of the cottage, as well as its name, are symbolized in its decoration and furnishing, the walls being decorated with mural paintings of landscapes and marine views.

The lighting fixtures will surely challenge your attention, whether you belong to the cult of illuminating engineers or not. They were designed especially for this cottage, and, as you perceive, are exquisite creations, and marvelous examples

FIG. 5.

FIG. 6.—DINING ROOM.

of the glass worker's art. In this reception room the chandelier bears lily-shaped blossoms, the center of each being a miniature electric lamp. A nearer view of the fixture is shown in Fig. 4. The roses blooming in profusion at the foot of the stairs are likewise luminous, the glass petals covering small electric lamps.

Looking toward the dining room from the other side of the stairs still other luminous bouquets meet the eye; and the chandelier might have been plucked from the marvelously beautiful flora and fauna of the bottom of the sea, so cunningly has the artisan reproduced in glass these exquisitely delicate forms. (Fig. 3.)

The decorations of the dining room (Fig. 6) are, if possible, even more unique. You seem to sit just beneath the surface of the ocean, and see the fishes swimming about you, as well as the ships upon the surface, and the sea birds flying overhead. The chandelier is in keeping with the surroundings, seemingly having crystalized the forms and fancies of marine life. It is more clearly seen in Fig. 5.

Has any one seen in this country a more unique or more fascinating installation of lighting fixtures? If so, let him now speak, or forever hold his peace.

The entire decorative scheme is fantastic, possibly even whimsical; but the location of the cottage is even more unusual, and fully justifies the complete departure from conventionality exhibited in its furnishing. After the endless repetition of classical, Colonial, Renaissance, and period furnishing and decoration, to look upon something that is absolutely different, and in which fancy has been given free reign, produces something of the feeling of exhilaration and rest combined that one feels on leaving the pavements and endless stretches of brick walls of the city and merges into the green fields and winding roads of the country.

Fixtures and Accessories

Lanterns for Interior Lighting

FIG. 1.—LOUIS XIV.

The lantern is primarily a device for so protecting a luminous flame from winds and draughts of air that it may be readily carried about either outdoors or in. In the earliest forms the flame was protected by sheets of perforated metal or thin pieces of horn. As the art of glass blowing was developed the lantern was enlarged and used to a much greater extent. Its original purpose, however, is so plainly apparent that even in its most modified form it suggests either a portable light-source or use in positions where it is exposed to the weather. But in spite of this fact lanterns have always been a favorite lighting device for interior use, and their popularity seems to show no signs of abatement. In halls and vestibules the use of the lantern is certainly in keeping with its purpose, as in such locations it is subject to more or less air draughts.

In every case justification for the lantern must be sought in the necessity of protecting a flame light-source. To place an incandescent electric lamp in a lantern is therefore absolutely incongruous: as if

FIG. 2.—LOUIS XV.

FIG. 3.—EMPIRE.

an electric lamp could be blown out! such incongruity, of course, does not openly manifest itself when the lamps are entirely hidden by the use of translucent media in the lantern; but unless such media be so highly absorptive that the lamp filament cannot be distinguished within it, the partial concealment of the deception only adds to the incongruity. Generally speaking, the modern lantern which uses diffusing glass is extremely inefficient, and its use hard to justify, either on the grounds of good art or economy.

A much modified, enlarged and refined form of the lantern is occasionally used, probably for no better reason than that they are to be found among the lighting installations that were designed in the French "periods." These lanterns were made to contain a number of candles, and, at least ostensibly, furnished a protection to the flames against air draughts. That this is their only possible *raison d'etre* is shown by the fact that in all cases clear glass was used in their construction.

Fig. 1 shows a lantern of the Louis XIV period in the palace of Versailles. It consists of a metal frame in which are set panes of beveled plate glass. Like all the other lighting fixtures in this famous palace, this lantern has been frequently copied with more or less fidelity.

Fig. 2 is a lantern of the Louis XV period in the same palace. It is hexagonal in shape and contains a finely designed chandelier for supporting three candles.

Fig. 3 is a lantern of the Louis XVI period in the Petit Trianon, Versailles. This shows an advance in the art of glass making, in that the panes are curved. It inclosed a chandelier which is elaborately wrought.

Fig. 4 is a lantern of still later design, likewise with curved panes of glass, and inclosing a highly decorative chandelier.

Fig. 5 goes a step further in the development of glass blowing, having panes

FIG. 4.—LOUIS XVI.

FIG. 5.—EMPIRE.

that are not only curved, but having curvature in two directions. It is of the Empire period, and belongs to the Grand Trianon. Instead of a chandelier it supports a candelabrum from the bottom. A clear glass smoke-bell is also a feature.

In the general contour of design, as well as the elaboration and refinement of ornamentation, these examples exhibit all the beauty that is characteristic of French decorative art during these periods, and hence serve as models for either exact copies or adaptations for modern use. In place of the chandelier or candelabrum, however, the ordinary incandescent electric lamps are commonly supported by the simplest possible means within the lantern. It is hard to conceive a more ludicrous example of imitative art than the reproduction of these lanterns thus fitted with modern electric lamps. If instead of using clear glass some form of diffusing glass were used the whole apparatus could be fully justified; it would be simply an arrangement for using a single diffusing globe surrounding the collection of lamps instead of an individual globe for each lamp—an arrangement which is both mechanically and artistically permissible. Such a modification, however, does not seem to have occurred to any modern fixture designer; but perhaps this is too much to expect, in view of the fetish worship which is bestowed upon French decorative art at the present time.

Stop, Thief!

"He who steals my purse steals trash."

As there are many forms of property other than those which can be measured with the yard stick or weighed in the balance, so there are many forms of larceny other than picking a man's pocket or making way with his spoons. Whatever doubt there may be as to a man's right to property derived from other sources, there is no question as to his exclusive title to that which he has produced with his own hands, or created with his own mind. Protection to the former class of property is comparatively easy to secure by the ordinary means available to civilized governments; but to insure one the possession of the products of his brain is a far more difficult accomplishment, and is only attempted in the more advanced stages of civilization. A couple of centuries ago the cavalier who indulged in the practice of relieving traveling gentry of their quick assets in cash and merchandise on lonely places in the highway were given short shrift when apprehended; while the original genius who produced a new poem, or play, or other work of art, had no protection whatever for the results of his labor, and consequently no means of securing material compensation except as a parsimonious gratuity bestowed through the

generosity of a public official or private patron.

That a man has quite as good a title to the work of his brain as to that of his hands was early recognized in the establishment of our own government, in the provision for the granting of patents and copyrights. Taken together the laws thus provided are intended to insure to every citizen a reasonable monopoly of the creative ability, whether it be in the line of mechanical or scientific invention, artistic design or literary production. But, while the purpose for which these laws were provided is accomplished to a considerable degree by the protection thus afforded, there is still endless opportunities for piracy in this field; and it is perfectly safe to say that no amount of written statutes can ever afford complete protection.

Every prosperous business house or individual at the present time is in the same position as the merchant vessel a couple of centuries ago, being always under the surveillance of pirates, and liable to an attack on any occasion which seems opportune. Nothing succeeds like success, except waiting for a man to make a success by his own energy and creative genius, and then coming in with a cheap imitation and harvesting where he has sown.

The sea pirate, even in the palmiest days of this hazardous profession, was a social outcast, and his life not worth a copper in any civilized community. The pirate of ideas, however, is almost wholly condoned by society, and entirely immune from the vengeance of the law.

While other lines of business are by no means uncommon in which the commercial pirate plies his trade, that of manufacturing and selling lighting fixtures seems particularly infested, if the testimony of those most familiar with conditions may be accepted. The success of the fixture manufacturer of the higher grade lies largely in the originality and ability of the designer; and, although the intent and purpose of the copyright law is to give protection to just this sort of creative talent, in the practical conditions and working out of the business the law is of little avail. It is true any design showing novelty may be covered by a design patent; but the opportunities for evasion by some slight variation, together with the endless trouble and expense involved in patent litigation, combine to practically annul the benefits which the law is intended to provide.

But the worst feature of the whole situation lies in the fact that the architect, upon whom the manufacturer depends for the larger volume of his sales, is of so easy a conscience in the matter that he often acts as a practical "fence" for the disposal of the stolen goods. The following incident, related by a large manufacturer, is doubtless typical of many similar cases.

The manufacturer was asked by an architect to submit designs and bids for the fixture installation of a certain prominent building. This, of course, involved the trouble and expense—neither of which was any small item—of originating a suitable line of designs, reducing these to practical working drawings and colored sketches, and making a complete estimate of costs. These were duly submitted to the architect by a personal representative of the manufacturer. After looking them over carefully the architect asked that they be left with him, in order that he might give them a more careful study. This request was granted, rather under protest. Not long after the manufacturer was notified that the contract had been awarded elsewhere. Thereupon the manufacturer requested the immediate return of his drawings. This was delayed through one pretext or another for sometime, until finally a personal visit by the representative was necessary in order to secure them. When the building was completed and the fixtures installed the manufacturer had the very equivocal pleasure of seeing the designs which he had submitted fully embodied in the fixtures.

The working out of the whole case is, of course, readily apparent. It is not impossible that had this been carried through the criminal courts a verdict might have been secured against the architect, but a conviction would have been cold comfort for the manufacturer. As a case of low down thievery such action is hard to surpass. The bandit who holds up an express train, and keeps the passengers at bay while he loots the mail sacks and ex-

press packages, commands a certain kind of admiration for his physical courage; but the meanness of the sort of stealing involved in the incident mentioned is not relieved by a single grain of either ingenuity or courage; it is simply downright robbery, and one who will perpetrate such a crime deserves no better treatment from society than is awarded to the most abandoned sneak thief.

Piracy in the fixture trade is further complicated by the fact that it takes place to a large extent among the members of the fraternity itself. According to general report the manufacturers are in one mutual combine to lie in wait for the appearance of designs which meet public favor, in order that they may make copies and reap the benefits of their competitor's efforts. The public cannot be expected to know, or to very seriously care, who is the originator of a design; the only solution of the problem lies in the concerted action on the part of the manufacturers themselves. It is a common evil and only common action toward the single end can effect the desired reform. A strong association of the fixture manufacturing interests could reduce the evil to a mere inconsiderable trifle, and could furthermore probably entirely eliminate the grafting tendencies of architects. Very much the same condition prevailed in the glass ware industry a number of years ago, but by organization and co-operation it has greatly mitigated. The only thing for the fixture trade to do is to get together, and the sooner the leaders make up their minds to do this the better it will be for both manufacturer and dealer.

HAMILTON COURT, GLASGOW.

With a constantly increasing tendency in this country to dwell in flats, the architecture of buildings of this nature becomes of increasing importance. The interior court is almost a necessity in such construction, and the question of its purely decorative features becomes a matter of proportionate consequence; and with the question of decoration comes likewise the question of lighting. The case may be considered as midway between interior and exterior lighting. The illustration shows the treatment of such a court in Glasgow, Scotland. The building itself is known as "Hamilton Court." As the photograph shows, the lamp-posts provide for both gas and electric lamps. The decorative standards, in connection with the flower vases and handsome fountain, form an architectural embellishment of a high degree of elegance and beauty.

Theory and Technology

Plain Talks on Illuminating Engineering

By E. L. Elliott.

XXI. Exterior Lighting: The Use of Globes and Reflectors. (*Concluded.*)

A wider distribution of reflected light may be obtained by continuing the reflected surface below the level of the radiant, as is shown in Fig. 7. The light reflected from the lower portion, as at P, passes under the radiant, and goes out on the other side in direction O, assuming that the reflecting surface is regular, or mirror-like. Reflectors of this shape have come largely into use of late, and are generally known as "bowl reflectors." Practically, they are useful only when made of prismatic glass, which has a peculiar combination of properties: the prisms act like mirrors upon a part of the rays, reflecting them regularly, and at the same time allow other rays to pass through in their natural directions. Such reflectors appear bright on the outside, and are, therefore, available for street lighting. It is evident that an opaque reflector of this shape would be entirely out of the question for this purpose, since it would hide the source of light entirely, and thus cut off its use as a beacon, leaving only the illumination on the pavement as a result; but a prismatic glass reflector can be seen as far as the bare radiant itself, and thus obviates this difficulty. The mechanical breakage, however, comes in when glass is used, and this must be carefully considered in connection with the conditions of the installation.

In the cases thus far considered it is only the general distribution that has been taken into account. The problem of utilizing the excess of light thrown out across the street is another problem still more difficult to solve. Prismatic globes have been made which give a considerable addition to the up-and-down street illumination. The distribution of such globes as compared with white enamel reflectors is given in an article on page 120 of last month's issue.

Another solution of this problem is to use two lamps on each post, each fitted with a reflector so placed as to throw the light lengthwise on the street in one direction. This may be the ordinary reflector fitted with an electric lamp, and placed at the desired angle, or it may be a reflector of a shape such as is used for window illumination, with a lamp placed vertically. The two forms are shown in Fig. 8. The perhaps fatal objection to all such arrangements is the excessive glare produced. To face one of these reflectors is like facing a searchlight, and would al-

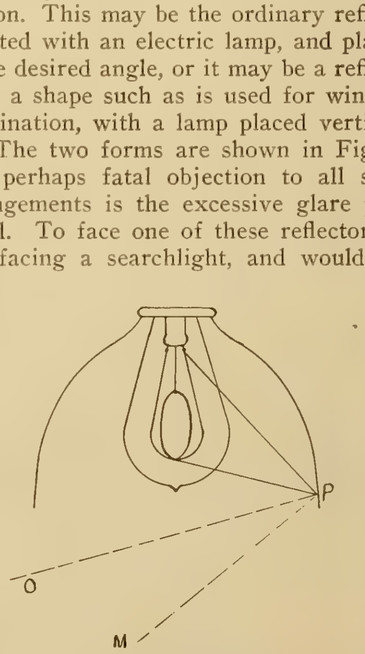


Fig. 7.

most totally incapacitate one from seeing anything else. An effort somewhat on these lines has been tried in San Francisco, we understand, where the lamps and reflectors are placed on the sides of buildings.

There are a number of modern light-sources which offer the reverse problem, *i. e.,* instead of throwing a portion of their light up and thereby wasting it, they throw the light down within so small an angle as to give an almost equally inefficient result. These are: the direct current, open arc lamp, now practically obsolete; the flaming arc, the first installation for street lighting of which is scarcely two months old; and the inverted mantle gas lamp, whose use thus far in this country is purely experimental, although it is very considerably used abroad. These sources present the rather curious problem of how to get their light up and out at a wider angle. Since there is very little light given out above the horizontal, reflection is evidently of little avail, although some slight gain might be effected with the bowl type prismatic reflectors. The only feasible solution of this problem seems to be the use of prismatic globes, acting by refraction. Very successful results have been obtained by this means in connection with the flaming arc lamp, as will be seen by examining the curves given in Fig. 9. The inner prismatic globe used in this case is made to serve the further purpose of preventing the collection of ash

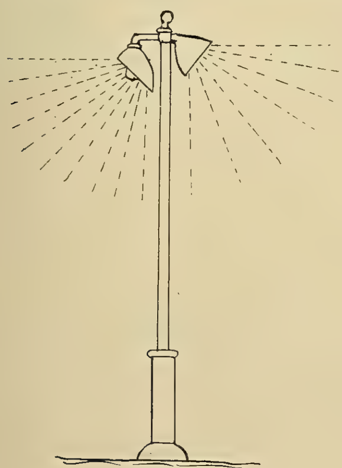


FIG. 8.

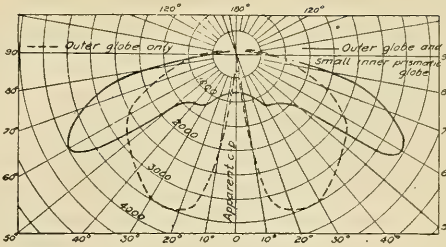


FIG. 9.

from the carbons upon the outer protecting globe, as well as keeping the prismatic globe itself clean. This is accomplished through a system of air currents, which are produced by the joint action of the globes and casing. Although we know of no actual cases in which such globes have been applied to the inverted mantle burner, there is not the slightest reason why equally successful results should not be obtained. If such burners come into any considerable use in this country for street lighting, it would be well worth while to seriously consider this method of improving their distribution. There is the same objection to glass on account of its breakage as when used for reflectors, and the additional objection that globes which all the light must pass through in order to be used for the desired illumination must be kept thoroughly clean, or the absorption of light will much more than offset any advantages of better distribution. The rule may be safely laid down that unless glass globes can be kept reasonably clean their use would better be limited to the absolute necessities of mechanical construction, and then only to smooth blown glass.

In the case of both the flaming arc and the inverted mantle burner the use of a globe of some kind is absolutely essential as a protection against wind and weather, and hence all advantages which may be obtained by the use of prisms on the glass may be easily utilized.

The following conclusions may be reasonably drawn from the preceding discussion: With carbon and metallic, or "luminous," arcs, incandescent lamps and upright mantle gas lamps, reflectors will produce a perceptible increase of illumination on the pavement.

Whether metal or glass reflectors are used will depend upon atmospheric con-

ditions. Where the air is frequently or continually smoky or dusty, as in the central portions of most large cities, and in all cities and town where soft coal is the principal fuel, metal reflectors are preferable to glass. In cities where hard coal is used, and generally in outlying districts, and in small towns, glass reflectors may be used.

The best form of metallic reflector is a very shallow cone, or flat disc, having a plain surface carefully enameled with opal glass—so-called "porcelain enamel." Such reflectors must be placed so as to intercept at least all the light above the horizontal.

With the flaming arc and the inverted gas lamp a much better distribution of the light can be obtained by the use of prismatic globes, which may be made to take the place of the plain glass globes that are generally provided.

Enameled metal reflectors should be used in addition to globes for protection against weather.

(THE END.)

The Regenerative Flame Arc

BY ISADOR LADOFF.

FIG. I.—THE REGENERATIVE FLAME ARC.

In our previous articles concerning mineralized carbon electrodes published in THE ILLUMINATING ENGINEER we treated pencils containing light-giving salts within their body. The salts were either mixed, intermingled, or conglomerated with the mass of the body of the carbon electrode or forced into one or many channels or cores.

The great disadvantage of these mineralized carbon electrodes consisted in more or less annoying formation of non-conducting or poorly conducting slags or scoria, and the latter was due to the lowering of the temperature of the carbon arc by the vapors emanating from the minerals.

Another drawback of the mineralized carbon electrodes was their exceedingly short life, due to an excess of air in the

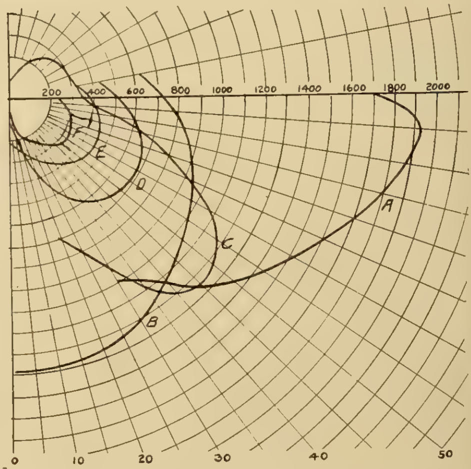


FIG. 2.—DISTRIBUTION CURVES.

A—A. B. REGENERATIVE FLAME ARC D. C. 5 AMP. 350 WATTS 1340 H. C. P. OPAL. OUTER GLOBE.

B—ORDINARY FLAME ARC D. C. 10 AMP. 500 WATTS 1070 H. C. P. OPAL. OUTER GLOBE.

C—OPEN ARC D. C. 9.6 AMP. 480 WATTS 880 H. C. P. CLEAR GLOBE.

D—SERIES INCLOSED ARC D. C. 6.6 AMP. 480 WATTS 540 H. C. P. OPAL. INNER GLOBE.

E—SERIES INCLOSED ARC A. C. 6.6 AMP. 425 WATTS 390 H. C. P. OPAL. INNER GLOBE.

F—MULTIPLE INCLOSED ARC D. C. 5 AMP. 400 WATTS 250 H. C. P. OPAL. INNER GLOBE.

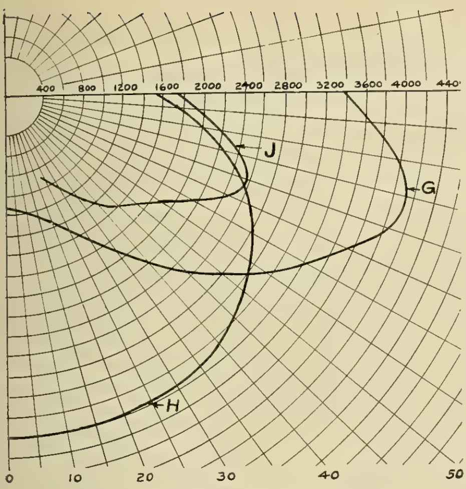


FIG. 3.—DISTRIBUTION CURVES.

G—A. B. REGENERATIVE ARC D. C. 7 AMP. 490 WATTS 2780 H. C. P. CLEAR GLOBE.

H—ORDINARY FLAME ARC D. C. 10 AMP. 500 WATTS 3150 H. C. P. CLEAR GLOBE.

J—A. B. REGENERATIVE FLAME ARC D. C. 5 AMP. 350 WATTS 1690 H. C. P. CLEAR GLOBE.

lamps in which they were burned. Various forms of dust collecting above the arc, designed to condense the fumes in which the current of gases are returned to the globe at points above the arc (Blondel's patent), and many devices relying for their operations on a constant current of fresh atmospheric air carrying the fumes upward through a filtering medium (Siemens' patent) lead to rather indifferent results. The globes of lamps with mineralized carbon electrodes always coated more or less into settled down condensed fumes.

The regenerative lamp takes care of both defects—*i. e.*, of the defects of the mineralized carbon electrodes and of the lamp in which they are burned.

The arc is enclosed in a transparent or translucent chamber, so arranged with suitable passages that the heat of the arc produces a strong draught through the arc chamber and past the arc, and a corresponding down-draught in the passages. The arc chamber and passages are so arranged that the latter are cooler than the former, and so disposed that they will not materially obstruct the light from the arc. The combination of the chamber and passages forms a circulating system of hot gases within a substantially air-tight chamber of small size. The enclosure is sufficiently air-tight and sufficiently small to obtain a comparatively slow combustion, and long life from the electrodes. No noxious fumes are allowed to escape into the surrounding atmosphere.

The transparent or translucent chamber is of cylindrical form of a small diameter. The chamber communicates above the arc with one or more tubes or passages leading downward to a point below the arc in the arc chamber. These tubes or chambers are formed substantially air tight. They allow free communication, however, between the upper and lower portions of the arc enclosure.

The temperature of the arc in its enclosure creates a strong up-draught of heated gases, which pass downward through the down-draught tubes, and hence upward past the arc. The down-draught tubes, being considerably cooler than the arc enclosure, condense a large portion of the fumes. The remainder are carried upward past and through the arc. In the arc the fumes turn again luminous.

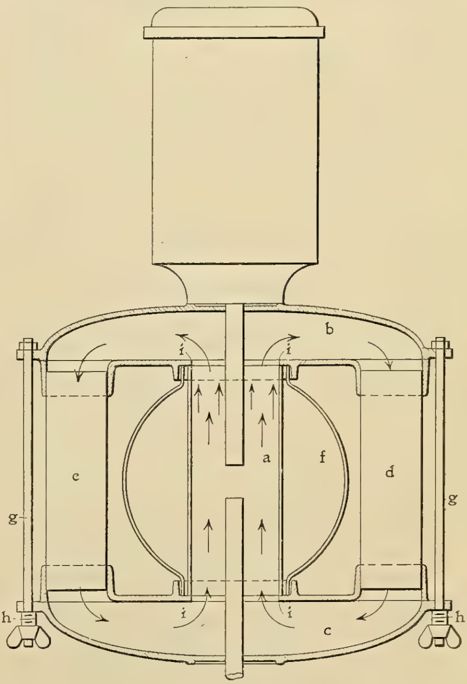


FIG. 4.

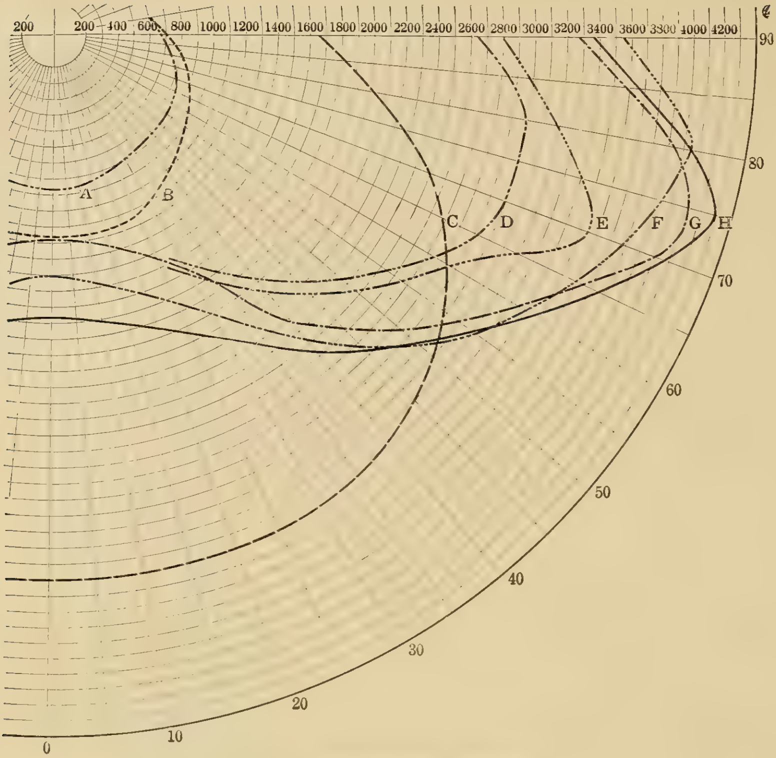


FIG. 5.—DISTRIBUTION CURVES.
A—A. C. EXCELLO 50 V. 10 AMP. ALABASTER GLOBE, 880 H. C. P.
B—D. C. EXCELLO 50 V. 10 AMP. ALABASTER GLOBE, 1070 H. C. P.
C—D. C. EXCELLO 50 V. 10 AMP. CLEAR GLOBE, 3150 H. C. P.
D—D. C. REGENERATIVE 70 V. 7 AMP. ALABASTER GLOBE, 2250 H. C. P.
E—D. C. REGENERATIVE. 70 V. 7 AMP., WITH REFLECTOR 2440 H. C. P.
F—D. C. REGENERATIVE 70 V. 6.6 AMP. CLEAR GLOBE, 2875 H. C. P.
G—D. C. REGENERATIVE 70 V. 7 AMP. CLEAR GLOBE, 2780 H. C. P.
H—D. C. REGENERATIVE 70 V. 7 AMP., WITH REFLECTOR 2980 H. C. P.

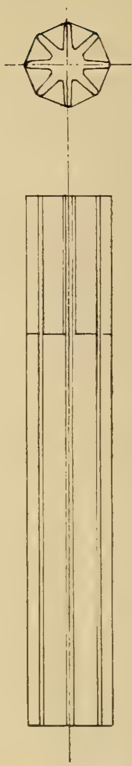


FIG. 6.—CORED CARBON PENCIL.

The illustration is practically self-explanatory (Fig. 4).

The light-giving electrode is the lower positive one. It is provided with six ribs. Without the addition of light-giving salts the pencil has a star-like cross-section. The space between the ribs is filled up with a light producing compound of calcium, tungsten and fluorine, the mass of the carbon pencil remaining free from any intentionally added chemical. When complete the electrode represents a hexagonal. It is about 6 inches long and about ¼ of an inch in diameter (Fig. 6).

The upper negative electrode is about 18 inches long and ⅝ of an inch in diameter, composed of pure carbon and supplied with one core for the direct and three cores for the alternating current.

The arc is established and maintained between the two carbon electrodes, and consequently of a considerably higher temperature than an arc between arc-light electrodes containing the light-giv-

Blondel's carbons show the following efficiency without globe:

					Without globes.			Excello.		
Amperes.	Volts.	Watts consumed.	Diameter of positive in m.m.	Diameter of negative in m.m.	Average lower ⬭ in H. C.	H. C. lower ⬭ per watt.	Watt per lower ⬭ in H. C.	A.	Watts.	⬭
4	35	140	10	7	550	3.93	0.254	6	330	1,300
6	35	210	11	7	1,400	6.68	0.149	8	440	1,780
8	39	312	12	8	1,900	6.10	0.164	10	550	2,450

ing salts within their body. The heat of the arc regenerative type is sufficiently high to vaporize the light-giving salts contained in the flutings between the ribs of the carbon. The vaporized fumes envelop, as it were, the carbon arc with a rich orange colored sphere. The resulting light is of a soft, warm color and penetrates far in the distance.

The mineralized arc light carbons of the brand Plania of Siemens show the following luminous efficiency:

Amperes.	Lamp voltage.	Watts consumed.	Diameter of positive lower in m. m.	Diameter of negative upper in m. m.	Without globes. Average lower ◯ in H. C. per watt	Watt per lower ◯	Watt per lower ◯ in H. C.
4	36	144	10	7	250	1.74	0.575
6	39	234	10	7	720	3.08	0.324
8	40	320	11	8	1,100	3.43	0.291
10	40	400	12	9	1,450	3.63	0.275
12	41	492	13	9	1,900	3.86	0.289
15	42	630	15	10	2,500	3.97	0.252

The ordinary carbon arc efficiency is:

A.	Watts.	◯ C. P.
6	330	475
8	440	751
10	550	1,045
12	660	1,365
15	825	1,946
20	1,100	2,920

The final report of the Committee to consider specifications for street lighting in 1907 (see p. 588, annual report to thirty-first Convention of 1908 of the N. E. L. A.) arrived at the following data:

First classification, Value X................5.5
4 amperes D. C., series luminous arc (Rutile Pencil).

Second classification, Value X..............4.0
9.6 amperes D. C. Series open arc.
6.6 amperes A. C. Series inclosed arc.
7.5 amperes A. C. Series inclosed arc.

Third classification, Value X................3.5
6.6 amperes D. C. Series open arc.
5.5 amperes D. C. Series open arc.
6.6 amperes A. C. Series open arc.

Fourth classification, Value X..............3.0
5.5 amperes A. C. Series inclosed arc.

The $X^2X\ 16 = $ C. P. of the source of light, the X value for the regenerative lamp is 11, when the amperage is 5 and the voltage across the arc is 70, the lamp hung at a height of 25 feet above the ground. In other words the regenerative lamp has a value for X double that of the luminous Rutile (Magnetite) lamp.

Technical Terms Illustrated

FIXTURES—HAMMERED METAL FINISH.

The Benefits of Better Street Lighting

To discourse upon the benefits of an improvement of such manifest and numerous advantages as good public lighting may seem like a waste of words. A good story, however, will always bear repeating, and the dissemination of knowledge necessitates "line upon line and precept upon precept." Heretical as it may sound, a popular form of government is not without its disadvantages, chief among which is the fact that public improvements must await the education of the majority of voters up to a full realization of the benefits to be derived. Science has progressed with such rapid strides in the last half century that public education can barely keep pace, with the result that affairs which are managed by public officials frequently lag behind the best practice shown in private enterprises. This constitutes one of the most valid objections to government control of functions which do not clearly and distinctly belong to the essential purpose of government.

A conspicuous example of private enterprise outrunning public administration of affairs is shown in the present movement for better street lighting, which has spread over the entire country with astonishing rapidity during the past year. The majority of the new installations are due wholly or in part to private funds; and it is perfectly safe to assume that private funds would not be expended for public utilities unless the benefits to be derived were unquestionable and adequate.

A movement which has become so general and attracted so much attention in a brief space of time is well worth careful study. A brief review of the situation from the various viewpoints may therefore be opportune. We may begin with the more practical aspects, and consider better street lighting first

AS A PROFITABLE INVESTMENT.

Generally speaking, the value of property on a business street is directly proportionate to the number of people who make use of the street as a thoroughfare. A corner lot on Broadway is worth more than a lot in the latest subdivision on Long Island, simply and solely because a greater number of people pass the Broadway corner during the day. It not infrequently happens that opposite sides of a street on the same block have considerably different values, due to the same cause. Anything which adds to the traffic of a given street must, therefore, add to the value of the abutting property. While conditions of accessibility to necessary utilities, such as railway stations, hotels, banks, public buildings, etc., have doubtless a preponderating influence in determining the traffic of a street, it is equally true that no subsidiary condition has such a vital effect as the lighting. Cincinnati has a long open square in the center of its business section, which naturally affords a prominent location for business. It happens that one side of this square has been brilliantly lighted up, mostly by private enterprise. As a result nine-tenths of the pedestrians in the evening take that side of the square, with the result that it is far more valuable as a business location than the opposite side. The merchants on one of Newark's main

business streets saw that the bulk of traffic failed to pass them in the natural course of business; they installed a brilliant system of street lighting, and forthwith their street became the center of attraction; and similar instances can be cited in numerous other cities. It would, of course, be absurd to expect to create a popular business street out of a thoroughfare lying far beyond the natural limits of traffic; but there is no question that any street directly tributary to a business thoroughfare can be fully doubled in value by the installation of spectacular lighting.

In a more general way, lighting the entire business section of a city up to the standards of modern illumination does for the city as a whole what the lighting of a particular street does for that section, it increases values by increasing the traffic, not only from the city itself, but from the surrounding country and nearby towns. That good light increases the value of residential streets by making them more desirable needs no argument. Good street lighting more than any other thing gives to a city an air of progressiveness and prosperity. "Nothing succeeds like success"; to appear prosperous is the first step to being prosperous.

AS A MEASURE OF PUBLIC SAFETY.

Before the days of systematic street lighting only those ventured out at night who had urgent business or ample bodyguard. City streets have become safe just to the extent that they have been well lighted. It is true that light alone would be insufficient protection, but it is equally true that police alone, in any reasonable numbers, cannot afford complete protection. While this fact is generally recognized, there is one phase of the matter on which more public education is needed. It is the practice in many cities, especially the smaller, to extinguish a considerable portion of the street lights at midnight or thereabouts, thus leaving them without this important protection for half of the night. To be sure, many streets are little frequented during this period; but a single breach of public order resulting in robbery or murder would more than offset the additional expense involved. A city in these days can certainly afford, and the citizens reasonably expect to have the fullest possible degree of protection every hour of the day. The midnight schedule is a piece of petty economy entirely out of keeping with the wealth and civilization of our country at the present time.

What is called the moonlight schedule is even a greater fallacy, if literally carried out. Moonlight is far too uncertain a quantity to be reckoned with in so vital a thing as street lighting. To consider the phases of the moon in a public lighting contract is as much behind the times as regulating the planting of crops or the prediction of the weather on this basis. A city should not only be lighted up adequately in every part, but should be kept lighted up during the entire part of the twenty-four hours when sunlight is not available.

AS A SANITARY MEASURE.

It would doubtless be stretching the argument to claim that better street lighting would directly add to the healthfulness of the street. The power of suggestion in influencing action, however, is no mere fancy; there is no denying the fact that one improvement suggests another. Asphalt pavement has produced clean streets, not merely because it is easier in itself to clean than cobblestones, but because of its much more elegant appearance; it shows more strikingly the offensiveness of filth and neglect. The same reasoning applies with greater force to the lighting of a street. Not only will well lighted streets be kept cleaner, as a matter of mere inclination, but will be less littered and abused. There is extremely little wanton destruction or injury to property of any kind. Such cases arise mostly from thoughtlessness or association, and not only will good street lighting be an incentive to keeping the streets clean and sanitary, but will further react upon the residents themselves with a wholesome influence to cleanliness.

AS AN INCENTIVE TO CIVIC PRIDE.

It has been truly said that in popular government, abuses are the penalty of neglect on the part of the governed. Civic pride is the surest step toward better municipal government. Anything which

adds to the general attractiveness of the city excites interest in its affairs, and fosters public spirit and civic pride. Every citizen should be able to "point with pride" to his own city; but how shall he do this when he sees such a woeful deficiency as poor public lighting? He may not be able to pass upon the relative merits of its public library, or the architecture of its public buildings, but public lighting is a thing of so conspicuous and evident a nature that there is no escaping the odium of an unfavorable comparison.

Of all things, then, let us have our cities well lighted. LIGHT UP AND KEEP lighted up.

Progress of the Magnetite Lamp

We predicted two years ago that the Magnetite, or Luminous, Arc Lamp was in line to succeed the enclosed carbon arc for street lighting purposes. The characteristics of this new form of arc so peculiarly adapted to street illumination that the prophecy of its ultimate success required no great amount of prophetic vision. A far greater efficiency in light production, longer life of the electrodes and a better distribution of the rays constitute a catalogue of virtues which give no room for doubt as to its future career. Reports have been coming in from time to time of installations of a somewhat experimental character in the smaller cities; and these have been gradually increasing in size and importance. So far as reports go these installations have given full satisfaction.

It is interesting to note that the Magnetite lamp offers a practical means of literally fulfilling the requirements of contracts calling for "2000 candle-power arc lamps," and furthermore of supplying a lamp of this power with a less consumption of current than the carbon arcs which have been in use for the purpose. The latest and largest installation of this type of lamp is that recently contracted for between the city of Boston and the Edison Electric Illuminating Company, of that city, involving the use of 3000 lamps. A small installation is also being tried out in New York.

While improvements will be made in the lamp, both in regard to mechanism and electrodes, the magnetite arc may now be considered as having passed the experimental stage, and may consequently be expected to replace carbon arcs at about the same rate that the enclosed arc replaced the open arc. While the tungsten lamp will unquestionably be largely used for street lighting, and the flaming arc also to a considerable extent, it is probable that the number of magnetite arcs will ultimately at least equal the number of carbon arcs now in use. Flaming arcs and tungsten lamps will represent additional street lighting, for there is an enormous field in this country awaiting development. From past history it would seem that lighting companies may count upon a complete revolution in lamps at ten year intervals, and hence may rightfully charge 10 per cent. a year on any given installation for depreciation.

New Uses for Outdoor Lighting

Modern light-sources have turned night into day for almost every purpose of labor or recreation. Construction work of all kinds is now carried on where desirable quite as rapidly by night as by day. The electric light and acetylene gas have made this possible and practical. The electric street railway and electric street lighting have given rise to a new amusement institution which can now be found in almost all cities and towns of any size —the recreation park. The institution, of course, is the direct result of the street car company's fondness for gathering coins; every traction company is a confirmed numismatist. But as the street car is a thoroughly useful and convenient thing, as is shown by the impatience of the people when it is blocked for even a half hour, so the summer recreation park is a decided addition to the attractions of a city. In the nature of things it is located in the suburbs, and in some spot as much favored by natural beauty as can be found. Reaching it necessitates a ride of greater or less distance through country or outlying districts, and the park itself, with its brilliant and fantastic lighting, and various mechanical pleasures which are so dear to the heart of the American cityite, combine to afford that

relaxation and exhilaration of mind and body which highly contribute to health and happiness.

Justice Brewer, of the United States Supreme Court, has declared that "golf is not a game, but a disease." If golf is a disease, baseball is contagious and well-nigh universally distemper. The present season will see at least two or three ball grounds equipped for night games by means of artificial illumination with electric arc lamps. Chicago, Cincinnati and Pittsburg are all to try it out. There can be little doubt of its success; for there is no practical reason why a ground should not be so brilliantly illuminated as not only to make the game possible in the highest state of the art, but to make it thoroughly visible to and enjoyable by the spectators as well. When this practice becomes general, as it undoubtedly will, the office boy will be spared the grief of so frequently attending his grandmother's funeral during the summer, and the business man, who is far too busy to receive an advertising solicitor, will not find it necessary to make so many trips to the neighboring city, nor have so many directors' meetings to attend.

But after all baseball is as tame as a game of croquet compared with the strenuous sport of selling suburban real estate in a Western town. The inducements offered to make a "home run" are so many and varied that if one does not fan himself out in the wild attempt to hit the right lot, he is fully entitled to score. At least one Western city intends to compete with night baseball by the real estate game. The lots are to be lighted up at night, not only so that prospective purchasers may find their way thither, but to such a degree that the lots may be fully inspected, and will present a spectacle worth twice the price of admission whether they buy or not.

And so the uses of artificial illumination continue to expand.

The Flaming Arc Lamp for Street Lighting

After being before the public three years in private installations for spectacular and commercial purposes, the flaming arc lamp has made a definite beginning in its career as a light-source for street and park illumination. Newark, N. J., has the honor of being the first to put up a street installation of flaming arcs. This installation has since been tripled in extent. Boston has come in with a small installation put up for demonstration purposes in Copley Square, its pet small park. As noted elsewhere in this issue, the main body of electric street lighting will be by magnetite arcs. That the flaming arc, however, has an undoubted place in public lighting is beyond question, and one of these places is evidently the lighting of small parks and open squares. Some objections have been heard to the yellow color of their light, but, so far as we know, this criticism has never come from the citizens. As a matter of fact, the color harmonizes exactly with incandescent lamps, which is an advantage in locations where there are numerous electric signs and lighted windows. No matter what the peculiar excellences or faults of any particular light-source, there is room for all.

The New Home of the Illuminating Engineeer

On June 1 The Illuminating Engineer will move to its new and permanent home at 36 West Thirty-ninth Street. The property at this location, consisting of a typical four-story and basement brown-stone mansion, has been purchased by the Illuminating Engineering Publishing Company, and will be redecorated and used in its present condition for the publication offices of the magazine. It is the intention ultimately to erect a substantial modern office building on the site.

The location was selected largely from the fact that it is directly opposite the United Engineering Societies' Building, which is the nerve centre of all the technical societies of national scope. Besides this, the location has the advantages of being midway between the two great railway terminals now nearing completion; but two blocks from the new public library, which will be opened some time within the present year; and within easy walking distance of the majority of the best hotels, theatres and retail stores, and but a half block from Fifth Avenue.

Notes and Comments

The Latest Use of "Wireless" Electricity

OMAHA ELECTRICAL SHOW ILLUMINATED BY ELECTRIC LAMPS SUPPLIED WITH WIRELESS CURRENT.

The first practical use of electricity was in the telegraph; and there are those still living who can remember the time when the first experimental line was erected. There are but two uses of electricity at the present time: to produce chemical action and to transmit power. The first telegraph line, with its supply of current from primary batteries, was merely an apparatus for transmitting small amounts of power; and the largest central station at the present time simply accomplishes the same thing on a larger scale.

The discovery of the means of transmitting power by electrical waves without the use of any solid conductor was likewise first utilized for the transmission of messages. The only thing that remains in order to perform all the functions which are possible with electricity, without the aid of wires or solid conductors, is to increase the energy of the electric waves at the generating point and receive it at the desired location. Between sending wireless messages by means of the most delicate instruments and in transmitting the power of Niagara for lighting a city or operating its railway system is simply a question of degree and not of kind.

According to press reports a very decided step toward such an end has been taken in a successful demonstration recently carried out at the Electrical Show in Omaha, Neb. It is stated that 4000 incandescent lamps were lighted for a period of four hours by electric current transmitted five miles without the use of any solid conductor, or, according to the popular expression, by "wireless." This remarkable achievement is said to be due to the discoveries of Dr. Frederick Millener, the wireless expert of the Union Pacific Railway. This may be only a newspaper story, but there is no reason to doubt that such results will be accomplished sooner or later.

Uncle Sam Gets in Line in the Movement for Better Street Lighting

WILL SPEND $25,000 TO LIGHT UP THE STREETS AROUND THE CHICAGO POST-OFFICE.

Chicago has one of the finest post-office buildings in the United States—probably the very finest outside of the Department building in Washington. It also has the distinction of being the first large federal building to have its interior lighting laid out by a practical illuminating engineer. As a result of the application of illuminating engineering principles the estimated cost of lighting was cut some $40,000 a year. According to the *Tribune,* the Government is now to put up an installation of street lamps around the block, which will correspond to the character of the building. The posts are to be of bronze, and be equipped with arc lamps.

Atlantic City's New Lamp-Posts Got Twisted

BRACKET LAMPS WERE TURNED PARALLEL WITH THE STREET INSTEAD OF AT RIGHT ANGLES, ACCORDING TO THE ARCHITECT'S SPECIFICATIONS.

Atlantic City's new lighting installation has been planned with much care, and is one of the best of its kind in the country. The corner lamp posts are much higher than the ordinary pole, and support an arc lamp on top and two lanterns containing clusters of incandescents on brackets near the bottom. It is plainly shown in the illustration in another part of this issue. It seems that in assembling these poles the lanterns were placed so as to be in line with the street, whereas the plans of the architects, Carrere & Hastings, of New York, show the lanterns at right angles to the street, so that one would light the sidewalk while the other lights the street, and thus give the appearance of a double row of lights. This mistake will be corrected.

It has also been proposed to suspend the arc lamp at the top at the end of a projecting arm instead of at the top of the

pole as at present, but this suggestion is opposed by the Business League. All of which goes to show the extent of interest taken by the citizens in a really good lighting installation.

St. Louis is Testing Luminous Arc Lamps

THE DOWNTOWN LIGHTING ASSOCIATION WILL TRY FIFTY OF TWO DIFFERENT MAKES FOR THIRTY NIGHTS.

The agitation by the above named civic association in St. Louis for better street lighting in the business section has been previously noted in these columns. The results of their labors will soon be made permanent in the shape of an installation of 2,000 arc lamps of the luminous or magnetite type. A trial installation of fifty lamps of two different makes was put up at the expense of the Union Electric Light & Power Company, at the request of the association after an investigation by expert engineers and an inspection of similar installations in Eastern cities. Definite conclusions have not yet been reached, but a formal report will be made at a later date.

Wants Better School Lighting

DR. WESTOVER, OF BROOKLYN, SAYS TOO MANY PUPILS ARE WEARING GLASSES.

New York City has been giving considerable attention in recent years to the eyes of the public school pupils, with the result that it has been discovered that an astonishingly large number of pupils have defective eyesight. The question of the cause and prevention of this serious trouble has been receiving considerable attention in consequence. It has been suggested that all the school text-books be printed on unglazed paper, and that half-tone engravings and small type be excluded. The possibility that the lighting of the schoolrooms has something to do with defective eyes seems to have at last been thought of. Dr. Raymond Westover, chairman of the Committee on Health of the Ridgewood Board of Trade, Brooklyn, asserts, according to the New York *Herald,* that there are 25 per cent. more school children wearing glasses in that section than in any other part of the city, and that investigation by his committee indicates that the cause is in the lighting system of the public schools.

Buffalo Continues to Show Signs of Awakening

BUSINESS MEN ON THE EAST SIDE ARE PRODDING COUNCILS TO GIVE THEM BETTER LIGHT.

Buffalonians who go out o' nights have heretofore been obliged to walk mostly by faith, but, as mentioned in our last issue, there are signs of better things to come. The business men on the East Side of its principal thoroughfare are now using their collective efforts to have their particular section of the business district adequately illuminated. The situation is thus set forth in the *Times*:

> Taxpayers and business men are united in their requests for better lighting facilities and intend to make a strong stand for the improvement. The several busy streets that the merchants desire to have better lighted are among the most important on the East Side and many large business establishments are located on them. The streets are so dark at night that several of the largest establishments have placed electric lights in front of their stores at their own expense.
>
> In replacing the old electric lights there are more streets to be considered than Main Street. It seems unreasonable that the business streets should be no better lighted than the residence streets.

"Hoosiers" Get the Lighting Fever

INDIANA CAPITAL TO HAVE A "GREAT WHITE WAY."

The prospects for better street lighting in Indiana are thus set forth in the *Municipal Journal and Engineer*:

> After working on the matter for two months, Mayor Charles Bookwalter has practically completed plans for making several streets in the downtown district a "Great White Way." The plan adopted is patterned after the scheme used in Fifteenth Street, Denver, which the Mayor recently inspected. All the street car poles in the chosen streets are to be removed and their places taken by extra heavy poles inclined four inches toward the property line. Each pole will be fitted with an ornamental iron bracket about two-thirds of the way up, and from this will be suspended an arc light.

There will be ten arc lights to the block. Enclosed arc lights will be used. An armored cable will be laid under the pavement close to the curb and the wires will be led to the poles through the gutter. The new lights will cost $74 a year. The Indianapolis Traction and Terminal Company will stand part of the expense.

Here and There in the Lighting Field

MISCELLANEOUS ITEMS OF INTEREST.

Toronto citizens will have to possess their souls in patience until 1911 before they can light up their homes with municipal electricity. Mr. Aitken, the head of the municipal electric department, however, says that he is "really going to light up the streets, not merely put a little light on each block giving a little spot of illumination under the lamp and leaving all the space between in darkness." The *Star* has been doing some figuring on the saving that will be effected to the average householder. In two cases it figures a saving for the year of fifty-two and fifty-four cents respectively; but this cheerful conclusion is rather spoiled by finding in the third case that the householder would have to pay ninety-two cents more to the city than he is now paying to the private company. In general, then, it seems that the chances are two to one that the ordinary householder will save fifty cents a year on his electric lighting bill with municipal electricity.

The Los Angeles *Examiner* is responsible for the following:

> The King Realty Company, Pacific Electric Building, has inaugurated an innovation by arranging to show lots at night, beginning to-night, in Southwest Heights, the property which it has placed upon the market and which is attracting much attention.
>
> More than 1000 flambeau torches will be used to illuminate the property, and besides serving a very practical purpose, will be spectacular.
>
> Two-thirds of the people of Los Angeles, it is estimated, are busy in the day and cannot go out to see this property, and it is for their benefit that the illumination has been arranged, and will be continued nightly.

Robert J. McCuen, Superintendent of Lamps and Lighting of Baltimore, is decidedly a live wire. He has been bracing up the public lighting of his city in all sorts of ways, incidentally making very considerable savings to the city, besides improving the quality of the illumination. He has now sprung a plan for a municipal lighting plant. He has been figuring the proposition over and will present his conclusions to the City Council.

Competition is the life of business, as is shown by the competition of the business men of the different sections of Newark, N. J., to produce the best and most attractive installation of spectacular lighting. Market street, which is one of the principal business thoroughfares, has a new installation nearly ready to go into commission, and the business men intend to celebrate the event in a proper manner. Score another for better street lighting.

District Commissioner Macfarland and Electrical Engineer Allen, of Washington, have concluded to use the very small appropriation made by Congress to increase the number of arc lights on a portion of Fourteenth and Fifteenth streets. This will show what can be done toward improving the illumination by increasing the number of arcs on business streets.

Peoria, Ill., has a Grand View Driveway, which it wants to light up in an up-to-date manner. The Park Board, believing that the bid of the local central station for supplying current is high, is contemplating putting in a private plant just for this particular installation. It will be well to think twice about this before going into the scheme.

The Potsdam, N. Y., *Recorder* of May 12 contains an article on "Illuminated Signs," which treats of the subject of street lighting from the time of Ninevah and Babylon to present conditions in Potsdam. The article contains the chief arguments in favor of better lighting of both streets and stores, and shows that the *Recorder* is a strictly progressive and wide-awake journal.

Americus, Ga., is to have a municipal lighting plant adequate to supply 300 arc lamps. Bids were advertised for and are to be in by the twenty-sixth of this month.

The movement to establish a municipal lighting plant in Orange, N. J., appears to be making substantial progress.

Correspondence

From Our Baltimore Correspondent

Occasionally we are brought face to face with facts that show the enormous strides that have been made in the lighting industry of this country. An illustration of the methods, scope and cost of lighting the city of Baltimore eighty-four years ago has been brought to light by the Superintendent of Lamps and Lighting, Robert McCuen, in the form of a small paper volume, being a report on municipal matters for the year 1825. It shows that the Police Department and the Street Lighting were under one and the same head, and that the total cost of lighting and policing the city for the year 1825 amounted to $23,920. The streets were then illuminated by oil lamps—as this was before the gas lamp and the electric arc were in existence. It was part of the duty of the police in those days to light the lamps and keep them in condition.

The cost of lighting for the year 1908 was $346,500, quite an increase over the modest $24,000 appropriated at that time.

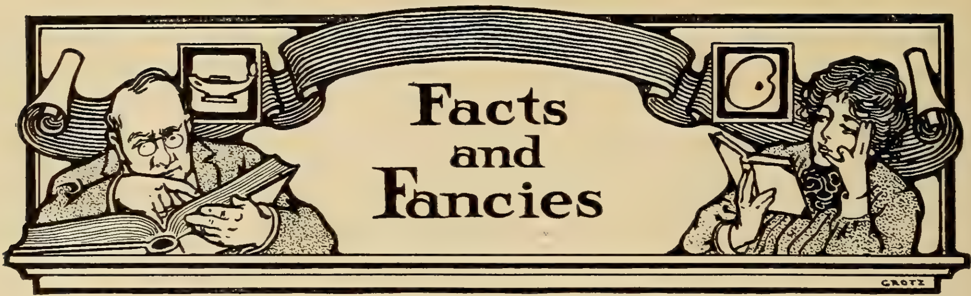
An ordinance has been introduced providing for the inspection and regulation of electric meters by the city. The purpose of the bill is similar to that now applying to gas meters, with the exception that it provides for the examination of all meters before their installation, for which a charge of ten cents each will be imposed on the electric company. There has been for some time a public demand for electric meter inspection, but the city was without authority to afford the relief demanded. It will be a source of satisfaction and protection to both the consumer and the electric company.

The new Graetzen gas lamps ordered by the Superintendent of Lighting have arrived, and are now being put up. Fifty of the lamps will be single burner, giving 140 c. p at a consumption, the manufacturers claim, of 3½ cu. ft. per hour, and fifty of the double type, with a c. p. of 256 at 6 cu. ft. per hour. If the photometer tests to be made by the department verify the statements of the manufacturers, these lamps will be the means of greatly decreasing the cost of gas lighting, as the present gas lamp used by the city gives 60 c. p. at a consumption of 3 cu. ft. per hour. A test has also been made in the laboratory of the Superintendent of the house burner type of Graetzen lamp, as follows:

No. 35, small size, with enclosing opal shade, gave 31.25 c. p. on a consumption of 2½ cu. ft. per hour. Without the opal shade the same lamp gave 43.75 c. p. horizontal. The larger size with opal shade gave 100 and 98 c. p. respectively on a consumption of 4.60 cu. ft. per hour; without shade 125 and 122.50 c. p. respectively on a consumption of 4.60 cu. ft. per hour; without shade 125 and 122.50 c. p. respectively at same consumption with a pressure of 2.10 in.

The plaza in front of Baltimore's new court house has been illuminated with two arc lamps of the inverted type, supported by concrete columns of ornamental design. Much criticism has been heard at the lack of harmony between these concrete posts and the marble columns gracing the entrance of this handsome building; marble would have been more in keeping with the dignity of a building erected at a cost of over three million dollars. However, if the lamps prove satisfactory, a number will be installed in the vicinity of the public buildings.

SYDNEY C. BLUMENTHAL.



Getting the Franchise

By Guido D. Janes.

Bill Basco was so blue and out of sorts that his face looked like a lot of Rousseau curves. He had been turned down twice; once by the board of aldermen of Eubanks, and once by his girl's father.

"No," remarked the alderman sternly, "you can't establish a central station here to light up the city. Kerosene lamps are good enough for us."

"No," said R. B. Partridge, "you cannot have my daughter until you install a lighting plant in Eubanks. You must first get the franchise."

"I won't give either up," he said aloud to himself as he sat in his room at the hotel an hour after receiving the ultimatum. "I will either get both or hang myself to a chain fixture. I will either lay out an installation or have the undertaker lay me out." He then put on his hat and coat and strolled over to Marjorie Partridge's house, where he had a date with her that evening. It was on Unit street, so he did not have far to go.

"Hello, Billie," cried the girl, answering the bell, "come in. I heard what father told you, and I inferred from that that the aldermen gave you knock-out drops, too. Don't feel irritated. I have a scheme. If it does not work we will elope."

"What's your plan?"

"This," and they sat down after turning up the light. "In five minutes we will go out into the park, and after finding a good dark place, we will hide until we hear some one coming, after which we will spoon in an audible manner. I mean make believe, of course."

"Is that all? Worse and more of it. Pretend to spoon and not do it, and feel all the time that you are a failure,—a burnt-out fuse,—an incandescent without any vacuum? No, I feel too out of sorts for that. If you don't object I guess I will go and 'Smith and Wesson' myself."

"All right. I will accompany you to be your second. No, honest though, the scheme I have in mind is bound to work. I commanded you to obey."

"Very well then, I will do as you say. I want to humor you in this last time we

"IS THAT ALL?"

will ever be together. Hang those aldermen."

"Yes."

The girl then hastily retreated while Bill put on his hat and coat, and by the time he had arranged his gloves she was ready. Out of the house they sauntered, thence down Unit street, thence into the park.

"Quick," whispered Marjorie as she looked behind and observed a figure coming up, "let's hide and get busy on this spoon business at once."

Obeying, though reluctantly, Bill followed the graceful figure as it darted in and out among the trees, etc., and soon found himself standing beside her twenty feet from the cement walk. "Let's start in," she said.

Meanwhile old man Gunther was jogging along at his usual pace. He passed by the two, heard something, paused, and said, "goodness," and other words of a similar character and import. "This is something that light ought to expose. I will have the aldermen put a kerosene lamp in this park." This he said as he rapidly walked away.

"I catch your point now," whispered Bill, indulging in some real spooning. "You are creating public sentiment against darkness."

"That's it, goosie; but, sh-h-h, here comes our minister. This will be the opportunity of our lives. Begin." (Bogus kiss.)

"What's that?" ejaculated Rev. Brinks. "Ah, I see. 'Tis the darkness parading in Satan's clothes. Whoever it may be doing that," he added, "should think of the consequences. Desist! *desist!* DESIST!"

"Kiss me again, darling," said Bill in a disguised tone of voice and ignoring the importunities of the sky pilot; "kiss me again."

This put the worthy gentleman to flight, and soon the two diplomats were astonishing and shocking other folks in the municipality, among whom was no other than R. B. Partridge himself. They then thought they had accomplished the object in view, and retraced their steps to the house.

Hardly had they gotten seated in the library when R. B. stalked in. He was quite out of breath, sore, and full of fight.

"Say," he began, without going through the formal ceremony of saying "good evening," "I want you to erect an electric lighting plant here in the city. While I was coming home just a few moments ago I heard something that I won't dare mention. And, sir, I am going to have that park lighted up with arc lights or move out of the city. I am not going to have my daughter contaminated by such occurrences. Why, I would not have had her hear those outrageous sounds for my whole fortune."

"You are very kind, sir, very kind."

"It ain't for you I am doing it," snapped back the old man, "it's for Marjorie. You say you have financed the scheme. Well, if you lack funds, call on me. This city can no longer remain in the kerosene age. I am going to circulate a petition to-morrow for your plant."

With this he wheeled about and walked out of the room.

"Darling," cried Bill, grasping Marjorie and embracing her, "you are the forty candle-power tungsten light that lumens my heart. Without you I would look just like a half-a-foot-candle. You are the two hundred and twenty volts that keep me going."

"Don't do that now," remarked Marjorie, not protesting at all though. "Wait until we get the central station installed. But wasn't that a funny way for father to give his consent? And didn't we fool him? Hee haw."

"Well, I should say yes. But I must go now. It is late. Gee, I am the happiest guy in Eubanks. And why shouldn't I be when I have in you a regular Bismarck and Gladstone and Root combined. Hurrah! Good night."

"Good night."

Bill didn't sleep a wink that night. No, he burned all the electricity he could lay his hands on, and turned the watt-hours into work. By morning he had a rough plant of an installation fixed up, and a draft of a sort of ordinance which permitted the poles to be erected and wires to be stretched.

Before he had finished his breakfast and

WE HAVE DECIDED TO LET YOU BUILD A LIGHT STATION.

while he was yet feeding himself to a bowl of oatmeal, the headwaiter came up to him and said there were three gentlemen in the office that wished to see him at once. Leaving the said oatmeal, Bill walked out of the dining room and went to the place indicated. It was Partridge and two aldermen.

"Good morning," said one of the latter. "We have decided to let you build a light station here after all. We will give you a fifty-year franchise. Mr. Partridge has already explained why we are doing this. And he was not the only one that heard it. Every one has, from myself to Rev. Brinks. When can you begin?"

"To-day, sir," was the reply. "I will telegraph for one of our engineers this A. M. We can light up Eubanks in three months at least."

"Good," remarked one alderman.

"Fine," said another.

Partridge did not commit himself. No, he just remained calm. But when the three started to leave he turned, and, after giving Bill a critical look, uttered a sort of satisfactory grunt and left.

Bill did not finish his feed. On the contrary, he strolled up to the hotel 'phone.

"Give me 356, please." (Pause.)

"Hello, Marjorie, is that you? Well, I will be down in a moment. It is all right. I have the franchise cinched. Good-by."

Hanging up the receiver, he hurried out of the hotel and made a beeline for Unit street.

CASHIER BOOKKEEPER CONTRACTS ADVERTISING

Commercial Engineering of Illumination

The Thirty-Second Convention of the National Electric Light Association

The thirty-second convention of the National Electric Light Association will convene at 10 A. M. on Tuesday, June 1, in the Auditorium of Young's Million Dollar Pier, Atlantic City. The program for the session, which will continue until Friday, the 4th, is an interesting document in itself, forming an epitome of the extensive scope and the enormous progress of the electrical industries. The subjects treated in the numerous papers embrace a great variety of subjects, from the most technical discussion of the various phases of the science of electrical engineering to such strictly commercial topics as bookkeeping and accounting. The plan inaugurated last year of collecting the opinions of a large number of experts on various subjects and presenting them under the editorship of a representative specialist is followed in the present program. This system met with great success a year ago, and will undoubtedly be equally commendable this year.

From a small gathering of men chiefly bent upon relaxation and diversion, with a few incidental discussions on matters pertaining to their common trade, the N. E. L. A. Convention has come to be a national gathering of men of varied and conspicuous talents, of both technical and commercial training, and devoted almost exclusively to the serious business of advancing the cause of applied electricity.

Each succeeding convention claims to be the most successful thus far produced, and with perfect truth. Electrical industries are growing at an enormous rate, and the association which represents them should grow, and is growing, proportionately.

1909 Programme.

TUESDAY, 10 A. M.

First Session.

1—President's Address.
2—Announcements.
3—Report of Committee on Uniform Accounting—H. M. Edwards, chairman.
4—Report of Committee on Progress—T. C. Martin.
5—*Private Policy*—Paul Lüpke.
6—Report of Question Box Committee.
7—Report of Committee on State and Company Branches—R. M. Searle, chairman.

TUESDAY, 8.30 P. M.

Second Session.

1—Opening Address.
2—*Street and Park Lighting*—J. W. Cowles.
3—*Methods of Manufacture of Incandescent Lamps,* Carbon, Metallized, Tantalum and Tungsten, Showing by Samples Various Processes—S. E. Doane.
4—Illustrated Lecture: *Quality of Light*—Paul Bauder.

WEDNESDAY, 10 A. M.

Third Session—Manufacturers' Day.

1—*Advanced Information Regarding Developments in Storage Batteries*—Joseph Appleton.
2—*The Regenerative Flame Lamp*—A. J. Mitchell.
3—*The Present Status of the Arc Lamp*

for Street and Interior Illumination—N. R. Birge.

4—*Recent Types of Arc Lamps and Their Operation*—C. E. Stephens.

5—Report of Committee on Meters—G. R. Green.

6—*Future Requirements of Central Station Companies*—P. Torchio.

7—*Some Recent Developments in Electrical Apparatus*—E. W. Allen.

8—*Distributing Transformers as of Interest to Central Stations*—E. G. Reed.

WEDNESDAY, 8.30 P. M.

FOURTH SESSION—Executive.

1—Report of Treasurer—John F. Gilchrist.

2—Report of Committee on Public Policy—Samuel Insull, chairman.

3—Report of Lamp Committee—W. W. Freeman, chairman.

4—Report of Insurance Expert—Wm. H. Blood, Jr.

5—Appointment of Nominating Committee.

THURSDAY, 10 A. M.

TECHNICAL SESSION NO. 1.

1—Report of Committee on Gas Engines—J. B. Klumpp.

2—*Some Features of Condenser and Cooling Tower Design and Operation*—M. R. Bump.

3—*The Use of Reactance Coils in Generating Stations*—P. Junkersfeld.

4—*Unique Features in Power Plant Design*—G. L. Knight.

5—*Efficiency of Motor Generators and Synchronous Converters*—F. M. Farmer.

6—*Transformers*—W. A. Layman.

7—*Low-Pressure Steam Turbines*—C. H. Smoot.

THURSDAY, 2.30 P. M.

TECHNICAL SESSION NO. 2.

1—Report of Committee on Grounding Secondaries—W. H. Blood, Jr., chairman.

2—Report of Committee on Protection from Lightning and Other Static Disturbances—B. E. Morrow, chairman.

3—Report of Committee on Overhead Line Construction—Paul Spencer, chairman.

4—*Recent Developments in Secondary Distribution Work*—W. K. Vanderpoel.

5—*Requirements and Specifications for Extra High Potential Transmission Lines*—Arthur S. Ives.

6—*Performance Specifications and Ratings*—W. L. Waters.

7—*Central Stations in Towns of Less Than 4000 Population*—J. S. Knowlson.

COMMERCIAL PROGRAMME.

THURSDAY, A. M.

FIRST SESSION.

Methods of Introducing Tungsten Lamps and Their Effect on Central Station Income—W. H. Atkins, editor.

Practical Illuminating Engineering in Connection with a Commercial Department—G. A. Sawin, editor.

Intensive Methods of Business Development—John C. Parker.

Can a Display Room Be Conducted Upon a Profitable Basis?—Frank B. Rae, Jr., editor.

Advantages to Be Derived from Uniform Commercial Department Forms and Methods—C. N. Stannard, editor.

THURSDAY, P. M.

SECOND SESSION.

Compilation of Load Factors—E. W. Lloyd, editor.

This paper to bring out the proper interpretation of the term "Load Factor."

Electric Power—H. J. Gille, editor.

The Advantage of Group or Individual Drive in Certain Installations—C. A. Graves, editor.

New York High-Pressure Fire System—Arthur Williams.

Relation of Electric Vehicles to Central Stations—J. T. Hutchings, editor.

Adoption of Electrical Heat for Industrial Purposes—Charles J. Russell, editor.

FRIDAY, A. M.

THIRD SESSION.

Electricity for National Advertising—George Williams.

Possibilities in Standardizing Bill-Board Lighting.

Illustrated.

Council of Progress.

Executive Session.

FRIDAY, P. M.

FOURTH SESSION.

Isolated Plants—R. S. Orr, editor.

Lighting.

Power.

Arguments Successfully Used.

Experience of Various Companies.

Central Station Operation of Steam Plants in Connection with Central Station Service—S. Morgan Bushnell, editor.

Novel Methods of Advertising in Small Towns—Alex J. Campbell, editor.

The Development of Revenue from Existing Customers—T. I. Jones, editor.

Electricity for Domestic Purposes—M. E. Turner, editor.

Installation.

Domestic Appliances.

Effect of Various Conditions of Maintenance on the Efficiency of Illumination—A. L. Eustice, editor.
Unfinished Business.

ACCOUNTING PROGRAMME.

THURSDAY, A. M. AND P. M. AND FRIDAY, A. M.

Depreciation—G. E. Claflin.
Payrolls—W. E. Freeman.
Cost Accounting—H. R. Kern.
Supplies—J. L. Bailey.
Branch Offices—E. J. Allegaert.
Customer's Accounts—L. M. Wallace.

The Passing of the Kerosene Lamp

The statistical department of the Standard Oil Company is an organization which keeps close watch over what is going on in the lighting field, with especial relation to the growth or decline of the consumption of illuminating oil. For a number of years it has recognized from a study of these carefully gathered statistics that every day sees a decline in the consumption of illuminating oil in zones in which gas and electric lighting industries are increasing.

At its great refining plants at Whitman, Ind., in the Chicago district, this corporation makes one-fourth of the illuminating oil consumed in North America. The time was when demands upon that plant for illuminating oil kept production behind demands; but of late, owing to the tremendous development of the gas and electric lighting industries in this zone the consumption of oil is steadily decreasing. Until a few years ago many more homes in the Chicago district were illuminated with kerosene than with gas or electricity, but since 1890 the consumption of kerosene has been reduced one-half.

The staggering figures of the growth of the electric and gas lighting industries in eight Western States within five years, and the consequent reduction in the consumption of kerosene, so aroused the Standard Oil Company that in 1906 they doubled their selling forces in the Orient, and went to large expense in popularizing American kerosene lamps in the richer parts of China. Mr. Joseph I. C. Clark, chief of the publicity department of the company, speaking to a reporter for THE ILLUMINATING ENGINEER concerning the remarkable trade in China for fine American hanging and table lamps, said: "Look at this brass table lamp on my desk. Within a year an Ohio lamp and fixture making concern with whom we deal sold us upward of one million lamps of that pattern, all of which we distributed in China. Our people have so worked in China and several other countries as to build up a great business for very fine American lamps and fixtures. China has millions of rich families who can gratify their tastes for anything they want.

"One of our agents sent home an account of a rich old official who has his palace set with scores of American hanging and table lamps of the finest patterns procurable. He has inspired a spirit of emulation among his rich neighbors that is helpful to American makers of fine lamps. We hear from a number of our agents in China that the increase in the electric lighting industry in a number of cities of that empire is notable. A number of Chinese, trained in the arts of pushing business by the electric lighting companies of our Pacific Coast, have gone back to China and are pushing trade so as to make enlarging markets for American made electric fixtures and supplies. This trade, like the demands for American kerosene lamps in China, is in its infancy."

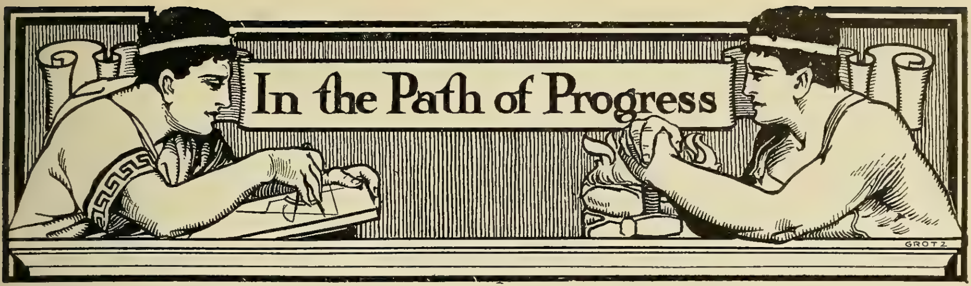
Visual Memory

If we swing a lighted stick in a circle and swing it fast enough, we will see a circle of fire, but why this is so cannot be understood. The light coming from the moving flame is focussed on the retina and for some reason the impression thereby caused persists for a fraction of a second, and by that time the circling light has made a complete revolution. That the impression on the retina must cease the moment the light is not focussed on it seems quite clear, so that perhaps the explanation of the phenomenon is one of memory. In the retina there are a million or so of nerve fibers, all of these taken together making up the optic nerve, but all these fibers have other ends somewhere in the brain, and it must be that the impressions brought to the brain by these fibers endure for a very short time, just as a piece of metal keeps hot after it has been taken out of the fire.—*From the Optical Journal, New York.*

Selling Fixtures on the Installment Plan

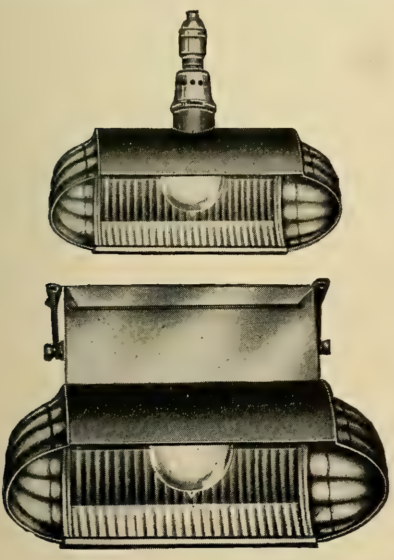
Within the zone of this city—18 miles from the City Hall—the population is almost 5,000,000. Seventy-five per cent. of the growth in the construction of dwellings within this zone since 1904 is to the credit of the boroughs of Brooklyn, Queens, the Bronx and Richmond. In Brooklyn Borough alone within five years 85,000 detached houses have been built and are owned by persons of small means. The average sum expended by each houseowner for gas or electric fixtures for houses of this class is $200. In parts of the boroughs of the Bronx and Brooklyn a great deal of building is going on in the form of detached houses for well-to-do Polish and Russian Jews, representative of a very large class in the zone of New York, who have struggled hard in order to lay by enough money to enable them to live in a detached house, as a happy relief from the disagreeable features of life in an apartment house. These owners of detached houses are liberal in spending money for fixtures for their parlors, sitting and dining rooms, and the best bed chambers. The florid designs of Oriental schools are preferred by these people. There are in town a number of clever young Polish and Russian Jew artists, educated in the best schools of design in Russia and Poland, who, for so much per design, furnish to a number of local fixture makers designs expressive of their national schools of art. This is strictly true of Russia, which has developed in all lines of metal working national forms which are as truly Russian as her poetry, music and architecture.

The inability of some of our long-established fixture makers to grasp the importance of the tremendous growth in numbers and riches of our vast population of Jews from Russia and Poland is responsible for the springing up in this city, and at a number of places in New Jersey, of fixture factories which are carried on almost wholly for account of this trade. Fixture makers who do not know the extent of this trade in Orientalized designs among the well-to-do, art-loving Jews are surprised to learn for about a year the larger installment houses in the furniture line have become sellers of gas and electric fixtures, which are installed by their own fitters. In speaking of this trade the buyer for the largest installment furniture house in the country said to a reporter for THE ILLUMINATING ENGINEER: "We put in fixtures by way of a feeler about two years ago. In the beginning we sold none other than reading lamps with big shades. Then we added dining room fixtures with widespread malachite glass effects and broad filigree brass insetments. We supposed that we should sell those goods to none but Jewish patrons. The Jews are a genial people, who like to gather about a well spread and lighted dining table. No other race reads so much at home. We found that our idea of lighting up a show window filled with library and dining room fixtures in our New York, Brooklyn, Bronx, Jersey City and Newark stores not only brought in lots of new customers among progressive Jews, but from other sources. So we added other kinds of fixtures, and now keep a large staff of men at work hanging fixtures for a hundred miles around. We sell a great many fixtures to people living in hired flats and houses, who like the idea of owning fixtures which are of higher types of design and of better finish than landlords will furnish. All the Western and Eastern cities are awakening to the fact that there is a good business to be had in selling fixtures on the installment plan. The time was when the selling of furniture on the installment plan was sneered at by the old-fashioned furniture trade. To-day the installment houses are new in the fixture business. But mark me, in two or three years our house will be selling as many fixtures by retail as any two of the biggest fixture makers in town are selling at retail under present conditions. Since January 1 our several stores have bought gas and electric fixtures and supplies to the amount of $67,000 at net cash prices."



A New and Efficient Device for Using Tungsten Lamps in Show Window Lighting

The use of the tungsten lamp for show window lighting has two highly important advantages—its high efficiency and the whiter quality of its light. In order to use it to the best advantage, however, necessitates special construction in reflectors. This is due to the fact that the lamp gives its best service only when used in the pendant vertical position. Economy of space also is generally an item of importance in the placing of show window lamps. A new form of reflector, designed to meet all these requirements, is shown in the accompanying illustrations. It is of metal and silvered glass construction, and so designed that while the lamp itself hangs in the vertical position, the position and reflector can be so adjusted as to throw the light in the desired direction, and to screen the light from the directions in which it is desirable to have the source hidden. The reflector is produced in units as shown, or in continuous sections of any desired length. It is manufactured by Klemm & Co., Philadelphia, and is given the trade name "Window Tungstoliter." The material and construction are first class, like all other apparatus of this well known house, and the device is practical and substantial. It is made to be used with 40, 60 and 100-watt tungsten lamps.



KLEMM "TUNGSTOLITERS."

Demonstration of Flaming Arc for Public Lighting

As announced elsewhere in this issue, the Edison Electric Illuminating Company, of Boston, has been awarded the contract for electric street lighting for the next five years, the luminous, or magnetite, arc being substituted for the enclosed arcs now in use. Much interest is centered about this contract by reason of the keen competition between the gas and electric companies for the contract. The Edison Company believes in not only doing its best, but in telling the public about it. The following announcement appeared in a quarter-page advertisement in the Boston papers recently:

A Demonstration of the Lighting in Copley Square.

To-night at 7.45 and at 8.15, by permission of the city authorities, the Edison Company has arranged to make a comparison between the Gilbert arc lamps, which have lighted Copley square for a number of years, and the General Electric flaming arc lamps just installed. The square is now lighted by three large flaming arc lamps, costing $468 per year. These lamps replace seven Gilbert arc

COPLEY SQUARE, BOSTON.

lamps, which have cost $828 per year. At 7.45 p.m. and again at 8.15 p.m. the flaming arc lamps will be turned out for five minutes and the old Gilbert lamps lighted, so that the public may compare them. Heretofore the plaza in Berlin, facing the Brandenburger Gate, which is equipped with electric flaming arc lamps, has been considered the best lighted square in the world. It is celebrated throughout Europe. Copley square is now lighted at a greatly reduced cost, yet it has more than twice as much light as when the Gilbert lamps were used. It is now better lighted than is Brandenburger square in Berlin, and Boston's own Copley square is now the best lighted square in the world.

THE EDISON ELECTRIC ILLUMINATING COMPANY OF BOSTON.

The above illustration, taken from a night photograph, gives a very adequate idea of both the evenness and intensity of illumination produced by this installation. The comparative height of the lamp-posts may also be judged by a comparison with the buildings. An idea of the comparative light flux of the flaming arc and the enclosed arc may also be obtained from the illustration. On this point it should be remembered that the enclosed arcs used in Boston are the larger size direct current lamps, which give the highest light flux of any form of enclosed arc.

The contract for the lamp-posts for this experimental installation of flaming arcs, as well as for the 3000 magnetite arcs that are to be placed throughout the city has been awarded to the Lundin Electric and Machine Company, of Boston.

Announcements

Phillip Semmer Company, manufacturers of glass Mosaics, have moved to their new plant and exhibition room, located at 401-5 Penn Avenue, Pittsburgh. This company, besides producing art glass windows, manufactures for the trade an extensive line of art glass shades and domes which are distinguished by a special copper setting, which finds much favor with the trade, which demands a high grade article, in place of the ordinary unguaranteed, cemented ware commonly furnished.

Mr. W. A. Purcell has been appointed San Francisco agent for I. P. Frink, manufacturer of reflectors, New York.

Proceedings of Technical Societies

The Illuminating Engineering Society

MAY MEETINGS.

New York Section.

Art in Public Lighting, by E. Leavenworth Elliott.

An illustrated lecture given in connection with the City Planning and Municipal Arts Exposition, at the Twenty-second Regiment Armory. Treated chiefly of the design of ornamental street lighting fixtures, showing American and European examples. In the introductory part of his lecture Mr. Elliott said:

The lighting of a city can be made attractive in two different ways: by the arrangement and effect of the lights themselves, and by the elaboration of the mechanical supports of the light-sources. It is probable that more attention has been given to these two phases of public lighting within the last two years than in all the preceding period of our national existence. The installation of decorative and spectacular lighting, in fact, is rapidly becoming—if it has not already become—a fad in America, and seemingly also throughout the civilized world. We are accustomed to think that no other people do things on quite so remarkable a scale as we Americans; but so far as public lighting is concerned, we can no longer lay claim to this distinction. Some of the European capitals, notably Berlin, in mere brilliancy of illumination, at least, surpass anything that we can show, even on the most glorious part of our Great White Way.

The past three years have seen revolutionary improvements in all means of producing light. It is a remarkable fact that both in the electric and gas fields improvements have been simultaneous and almost equally startling. In place of the carbon arc, which was the wonder of the world thirty years ago, we now have the flaming and metallic arcs, which by comparison make their prototypes look like candles. In place of the flickering yellow gas flame we have the high-pressure incandescent gas lamp, equaling or even exceeding in light power the enormously powerful electric arcs; and in place of the familiar electric bulb, we have the brilliant and economical tungsten lamp. Speaking in round numbers, the improvements in producing light, both by gas and electricity, have reduced the cost to one-third of the previous rate. When, in addition to this, we also consider that the cost of producing illuminants—gas and electricity—and their selling price, have been cut in half within the past ten years; and that many of our cities have doubled in population, and all have increased in wealth enormously in the same time, it will be readily understood why this demand for better public lighting has taken such quick and effective hold upon the public.

Philadelphia Section.

Eye Strains, by Dr. Walter L. Pyle.

A Short Review of the Work Accomplished by, and the Purposes of, the Illuminating Engineering Society, by President W. H. Gartley.

The papers are not yet available for review.

Boston Section.

Physiological Effects of Illumination, by Sydney W. Ashe.

The following are excerpts:

(1). The result of the investigation has so far shown that with lights differing in color of the same luminosity, as determined by the Rood flicker photometer, the diameter of the pupil of the eye varies, being largest for red, then green, white being intermediate.

(2). By comparing a green light, and a reddish-white light, such as an incandescent lamp, in different angles in the field of vision, it was noticed that the pupil contracted more for green light, the difference between the two increasing as the angle increased.

I will say for this green light that it was not an entirely true color, and that this color must be remeasured; but for the red there was a decided difference in the size of the diameter of pupil for different colored lights of the same intensity. In other words, the pupil does not react as effectively to red light as for white light, and will not contract the same amount. Of course the white would give us a sort of average value. It may be noted that if the diameter of the pupil is different for the same intensity of light, the pupil will act like a stop, or diaphragm, in a camera; and if for a given intensity of light the pupil stops down for one more than for the other, we are going to have a greater sharpness, and we can therefore read better with one than with the other. We found that for the same color and the same luminosity we could read a greater distance for the colors in the lower part of the spectrum—blue—than for the colors in the upper part—red. Irrespective of the intensity of light there would be a certain maximum reading distance beyond which you could not read a letter, no matter how much more it was illuminated. These tests were carried on in different ways. We used the flicker photometer for measuring the light. The lights were shielded from view, and the Snellens chart was put up. The reading distance on a Snellens chart is the distance for reading at normal vision. Snellens selected an angle of 5′ as being the normal visual angle. He called this the reading distances for each sized letter, as marked on the chart. If you can read at twice the distance indicated, your acuity would be two: this is what visual acuity means. Unity acuity is the reading distance which subtends an angle of 5 degrees, as previously noted. If you wanted to compare another acuity with unity acuity you would simply divide one into the other. If you could not read the 30-meter line on the chart beyond 15 meters you would have only half acuity. Suppose you had a letter E and it was illuminated from one side with a 16-c.p. light so that you could see the light; how much would the presence of the light decrease your ability to read? It would decrease it about 30 per cent. This is due, as one can see, to the fact that light enters the eye from the 16-c.p. lamp and tends to flood the retina of the eye with an excess of light-flux. This tends to alter the sharpness of that image focused upon the retina, so that you cannot read it at the same distance you could otherwise.

The pupil contracts more for the same intensity of light at the same angle for green than it does for red, as previously noted. This may possibly explain why with the Cooper Hewitt tube you get this apparent magnifying power,—because for the same luminosity the pupil will contract more, and in contracting more there is a greater sharpness. Another thing, of course you have a much greater diffusion surface which is apt to cause the pupil to still further contract. It may be the result of both of these two things. This contraction is very readily noticeable.

Chicago Section.

Instruction in Illuminating Engineering, by W. E. Barrows.

After a general argument to show the importance of illuminating engineering, and the necessity for trained engineers, Professor Barrows described the courses being offered in this branch of science at the Armour Institute of Technology, Chicago. In September, 1907, a short course relating to the principles of illuminating engineering was established at Armour. It was given to senior students and consisted of notes of instruction, principally from technical magazines, supplemented by lectures. This course has been developed and enlarged, and is now offered as an elective to juniors and seniors in electrical engineering, and is chosen by about half of them. In the development of this course considerable original work has been accomplished in working out constants for mathematical calculations and in other directions.

MARYLAND STATE OPTICAL SOCIETY.

Waves of Sound and Light, by Justice Stahn.

A popular explanation of the theory of light, using the phenomena of sound as an analogy.

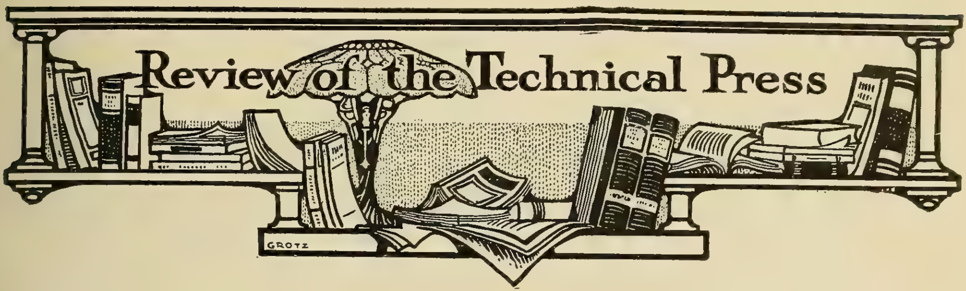
The Physiology of Vision, by B. W. Hazell.

A simple exposition of the theory of lenses, and the construction and action of the eye.

FRANKLIN INSTITUTE.

The Theory and Practice of Illumination, by Thomas W. Rolph.

An exceptionally clear and concise review of the theory of illuminating engineering.



American Items

NEW PUBLICATIONS.

Journal of Gas and Electric Fixture Trades and Allied Arts, and Illumination.

We noted the appearance of a new trade paper under the title "Illumination" in our last issue. It comes out in its second number with the additional title given above and under new management, being published by the Fixture Trade Publishing Company, 324 Dearborn street, Chicago, Ill. John F. Byrnes is the editor and general manager.

It is of the regulation trade paper size, thirty-six pages and cover, and its subscription price one dollar a year. The scope of the paper is fairly well indicated in its rather lengthy title. The general make-up of the text, both from the literary and mechanical viewpoints, evinces a definite purpose and policy on the part of the editor, as well as a knowledge of the technics of trade journalism. The issue contains a number of interesting articles, fully illustrated, portraits of the authors being generally given. The leading articles are as follows: Brilliant House Illumination, by Wesley A. Stanger; The Dome Chandelier and Fringe, by E. D. Caffrey; Using Sun's Rays Scientifically, by R. L. White; Uncle Sam's Petroleum Record, by Waldon Fawcett; Persistence, Judgment and Salesmanship, by J. E. Bullard; Success of Cooper Hewitt Lights, by George C. Keech.

The leading editorial takes for its title "Are You in Favor of an Organization of the Gas and Electric Fixture Trades and Its Allied Interests?" and is a strong appeal for the formation of such an association. The necessity for such co-operation has been set forth in The Illuminating Engineer from time to time, and we congratulate our contemporary on taking up actively the promotion of this very worthy project.

Besides the leading article and editorial, there are several pages of miscellaneous and trade news. Altogether it strikes us that this is the best first issue of a trade journal that we have ever seen, and we wish it most abundant success.

Light and Illumination, by A. J. Marshall; *Light,* May.

In Chapter Three under this department heading Mr. Marshall discusses "A Well Defined Policy" and "The Forerunners of the Arts."

Commercial and Domestic Lighting, by T. J. Rutledge (*Light,* May).

The article is a very timely appeal to the gas interests to be more vigorous in pushing the lighting end of the industry, and for better fixtures, lamps and general practice in gas lighting.

The Progressive Motion of Light, by F. W. Warren; *The Optical Journal,* May 20.

Gives a popular explanation of the method by which the velocity of light was first determined.

EDITORIALS AND UNSIGNED ARTICLES.

The Committee Versus Exhibitors (*Light,* May).

A genial reply to an editorial in The Illuminating Engineer commenting un-

favorably on the general illumination of the Gas Appliance Exhibition in Chicago last winter. The principal argument is that gas light is unsuited for spectacular purposes, and that such illumination would have been an injustice to the exhibitors of gas lamps.

CONTRACTS FOR PUBLIC LIGHTING (*Engineering Record,* May 22).

A discussion of the contract recently made for the public lighting in Boston.

This contract is for 3000 magnetic arcs, and the specifications are therefore of special interest. On this point the editorial says:

The technical difficulty in drawing a contract for lamps of this radically new species, or any other new species, is to find a suitable basis of comparison between the old and the new without being driven to an actual photometric comparison upon the street. A contract for arc lighting, or incandescent lighting for that matter, is not a contract for the delivery of a certain amount of electrical energy or of a certain amount of light, but it is essentially a contract for service. The operation of an arc-lighting system involves a great deal besides the sale of a certain specified amount of energy or the delivery of a certain minimum amount of light. It implies a complicated system of distribution and the upkeeping of some hundreds or thousands of somewhat delicate mechanisms. It involves, moreover, such watchful supervision over the whole territory lighted as will insure continuous and reliable light in all kinds of weather and under all kinds of trying circumstances. Such a contract, therefore, is one for service in which the energy supplied and the light delivered are factors, to be sure, but hardly of controlling importance; keeping the lights going all the time and burning steadily every night in the year is much more important from the standpoint of the city than a few watts or candle-power, more or less.

Hence one of the most satisfactory forms of contract is that which requires regular lighting by a certain specified type of lamp of which the energy input, readily measured, is stated merely as a matter of precaution, but when there is under way a very radical change in the efficiency of the illuminant—that is, in the amount of light delivered on the street by the specified lamp—it becomes difficult to make a formal contract without some sort of specification of candle-power. This from a technical standpoint is highly objectionable and from a civic standpoint hardly less so, for everyone who has had experience in measuring candle-power, particularly of arc lights, knows to his sorrow that such measurements made upon the street can never be expected to reach a high degree of precision. Even the most conscientious observers, through necessary difficulties of the measurement and the necessary lack of exactness in the indications of the instruments, may vary enough to produce very serious discrepancies. What is worse, the moral hazard, so to speak, in candle-power measurements made upon the street is a very large one. It is perfectly possible for two observers measuring the same lamps side by side to reach results at variance by 20 per cent. or more, merely by different habits of observing the somewhat fluctuating light of even the best arc lamp. An observer who had an inclination to appreciate or depreciate the power of the lamps could do so by 10 per cent. or more with a comparatively clear conscience and with an inward conviction that he was not departing from the substantial truth. It is perfectly obvious that if contracts for services rendered were based on measurements so made there would be a constant litigation.

GAS AND ELECTRIC COMPETITION FOR BOSTON STREET LIGHTING (*Electrical Review and Western Electrictrician,* May 15).

Briefly describes the efforts that were made by the gas and electric lighting companies to secure the street lighting contract.

THE TECHNICS OF ARC LAMPS (*Electrical World,* May 13).

A review of a paper by Dr. Monasch on the subject appearing in a recent number of the *Electrotechnische Zeitschrift.*

ARC STREET LIGHTING IN MANCHESTER, N. H.

A description of the installation in that city.

SPECTACULAR ELECTRLC SIGN ADVERTISING.

Describes some of the prominent electric signs in New York and Chicago.

IMPROVEMENTS IN THE QUARTZ LAMP (*Electrical World,* May 20).

STREET LIGHTING IN CHICAGO (———).

Foreign Items

Compiled by J. S. Dow.

ILLUMINATION AND PHOTOMETRY.

Trotter, Illumination, Its Distribution and Measurement (continued; *Illuminating Engineer*, London, May).

The present section contains some discussion of photometric scales and the "compensation" or "double-weighing" method of using photometric benches.

Report of the Conseil d'Hygiene on Factory Lighting (abstracted in the *Illuminating Engineer*, London, May).

Gives a *résumé* of the legislation in France affecting factory lighting and also contains a short summary of the regulations in force in other countries. The exclusive use of artificial light only in factories is condemned, and some sound recommendations regarding keeping sources of light outside the field of view are put forward. It may be noted that in Holland a definite regulation affecting the intensity of illumination (in workshops) which is not to be less than 1 foot-candle, is stated to exist.

Visual Acuity and Light of Different Colors, by Prof. L. Weber (corres. *Illuminating Engineer*, London, May).

Describes some experiments devised to compare the methods of equality of brightness, flicker and acuteness of vision as applied to heterochromatic photometry. The author comes to the conclusion that the method of using colored glasses in front of the photometer is the best plan.

EDITORIALS.

Photometrical Terminology (*G. W.*, May 1).

Discusses and abstracts an article by Professor Weber which appeared some time back, dealing with the relative merits of the terms "lux" and "meterkerze."

Illuminating Engineering Progress (*Elec. Engineer*, April 30).

Is based upon the review of the past year's progress as summarized in The Illuminating Engineer of New York, for March of this year.

ELECTRIC LIGHTING.

Die Neue Form der Quarzlampe von Dr. Küch, by O. Bussmann (*E. T. Z.*, April 28).

Contains a summary of the chief qualities of the quartz-tube mercury lamp invented by Dr. Küch; special explanation is given of the regulation of the current through the lamp, and of the action of the ballasting series resistance.

Enseignes et Affiches Lumineuses, by de Kermode (*l'Electrician*, May 8).

This article describes a number of devices for switching on and off groups of lights on illuminated signs. This is usually accomplished by a small motor with special commutating device, but methods of using the heat generated in a resistance coil to produce a periodic action are also explained.

Tantalum and Its Uses, by A. Siemens. (Lecture delivered before the Royal Institution, London, on April 23; abstr. *Electricity*, May 14.)

The Electric Lighting of Railway Signal Lamps (*Elec. Engineer*, May 14).

The author points out the advantages of electric lighting for signals, etc., in railway work. Apart from its convenience to manipulate and its easy application to out of the way places, electricity has other merits. For instance, the author points out that lights in signal lamps have usually to be mounted in more or less restricted enclosures, such that oil-flames rapidly deposit a film of smoke on the lenses and reflectors. One difficulty which has to be provided against is the prevalence of vibration. For this and

other reasons carbon filament lamps are often preferred.

A Patent Disc Arc Lamp (*Electricity*, April 30).

A notice of a newly introduced arc lamp in which the usual rod-carbons are replaced by carbon discs.

Einheitliche Bezeichnung von Bogenlampen (*E. T. Z.*, May 13).

A series of recommendations issued by the Verband Deutscher Elektrotechniker regarding the terms to be used to describe arc lamps. It is recommended that the following points should be clearly specified in so doing: (1) Whether lamp is open or enclosed; (2) position of carbons relative to one another, *i. e.*, whether vertical or inclined; (3) variety of carbons; (4) nature of current. The various terms implied are also defined.

GAS, OIL, AND ACETYLENE LIGHTING, ETC.

Les Lampes de Mines à Acetylene, by A. Buttin (*Revue des Eclairages*, April 30).

An article dealing in detail with various types of portable acetylene lamps for mines, and describing the various types of generators used therewith.

Some Notes on Incandescent Gas Lighting, by Dr. R. C. Böhm (continued; *The Illum. Eng.*, Lond., May).

The present section of this serial article describes a number of patents on the subject of artificial silk mantles.

The Influence of Surfaces Upon Gaseous Combustion, by W. A. Bone (*G. W.*, May 8).

The Meteor Illuminating Oil, by Dr. C. Charitchkoff (*Illum. Eng.*, Lond., May).

EDITORIALS.

The Supply of Electricity by Gas Companies (*G. W.*, May 1).

The Hygiene of Lighting Interiors (*G. W.*, May 8, *Elec. Review*, April 30).

A discussion that has been proceeding in the columns of these two journals on the old question of the influence of gas-lights on the atmosphere and ventilation of interiors.

The Management of the Consumer, T. V. Fehn (*G. W.*, May 1).

Cinematographie et Acetylene, by H. Poncelet (*Rev. des Eclairages*, April 30).

The Keith High Pressure Gas System for Lighting and Heating, by H. A. T. Stokes, (*J. G. L.*, April 27).

Summarizes the recent advances secured in high pressure gas lighting by the aid of preheating the gas and other means in the new Keith light; this lamp, with a pressure of 54 in. of water, is said to yield between 60 and 70 candle-power per cubic foot of gas.

High Pressure Gas Lighting, by Dr. H. Strache (*Illum. Eng.*, Lond., May).

A short article discussing the chief theoretical data on which the efficiency of high pressure gas lighting and the production of the correct proportions of gas and air depend.

Bücher und Broschuren auf dem Gebiete der Gasindustrie (*J. f. G.*, May 8).

A list of a number of books, published papers and periodicals in different countries, dealing with gas lighting and gas manufacture.

The Ross Patent Mantle (*J. G. L.*, April 27).

Acetylene for Village Lighting (*Acetylene*, May).

Acetylene for Village Rifle Ranges (*Acetylene*, May).

Neuere Anlagen zur Erzeugung von Mischgas, Etc. (*Z. f. B.*, April 30.)

Contractions used:
E. T. Z. *Elektrotechnische Zeitschrift.*
G. W. *Gas World.*
Illum. Eng., Lond. *Illuminating Engineer, London.*
J. G. L. *Journal of Gaslighting.*
J. f. G. *Journal für Gasbeleuchtung und Wasserversorgung.*
Z. f. B. *Zeitschrift für Beleuchtungswesen.*

The
Illuminating Engineer

Vol. IV JULY, 1909 No. 5

LIGHT IN MODERN LIFE

In the early dawn of civilization man was given to worshiping fire, the sun, and the other luminaries. It was a natural result of the instinct to adore that which affords comfort and pleasure.

Suppose our modern light-sources to be abolished: what a curtailment it would make of the pleasures and delights of open air recreation!

Modern lights have made travel by night as safe as by day, both by land and water, and thus had a far reaching influence in the annihilation of space which has brought mankind so much nearer together.

When the play is over the lights are put out: darkness is the symbol as well as the cause of mental gloom and of bodily inactivity. All our open air recreations, which play such an important part in our present day civilization, are based upon modern illumination; they had no counterpart in ancient times.

Light is an unmixed good; it extends our opportunities for useful employment, and our facilities for pleasure and recreation. Because it has become so common and so cheap, let us not forget what we owe to illumination for the diversions of our leisure moments, as well as the performance of the duties of our working hours.

LET THERE BE MORE LIGHT.

E. L. Elliott

FIG. I.—EUROPEAN BUILDING.

Spectacular Lighting at the Alaska-Yukon-Pacific Exposition

Spectacular lighting had its birth at the World's Fair in 1893 in Chicago. While more elaborate and expensive displays have been made since, it is doubtful if any similar installation will ever arouse as much genuine awe, admiration, and enthusiasm as did this marvelous piece of lighting. It was the first revelation of the possibilities of the electric light in the production of scenic and architectural effects. Whoever had the good fortune to sit in the "Court of Honor" at the close of day, and gaze upon the superb architectural creations about him, transformed into sculptured marble by the mellow light of the setting sun, and as the outlines dimmed in the gathering dusk, to see the whole turned into a vision of endless lights, multiplied by reflection in the still waters of the lagoon, will never be convinced that any other spectacle could be quite so fairy-like and beautiful. Besides its unquestioned inherent beauty, this installation also had the advantage which no other will ever possess—namely, of being the first of its kind.

It is a matter of course nowadays that any kind of festivity, from a lawn fete to a world's fair, will be illuminated with as much brilliancy and with as many novel effects as expense and ingenuity can produce. The question that the promoters of this last of the expositions had to decide was not shall we use spectacular lighting, but how shall we use it to secure the most novel and pleasing effects? A number of night views that are herewith presented show that outlining with incandescent electric lamps has been depended upon almost exclusively. Outline lighting is an

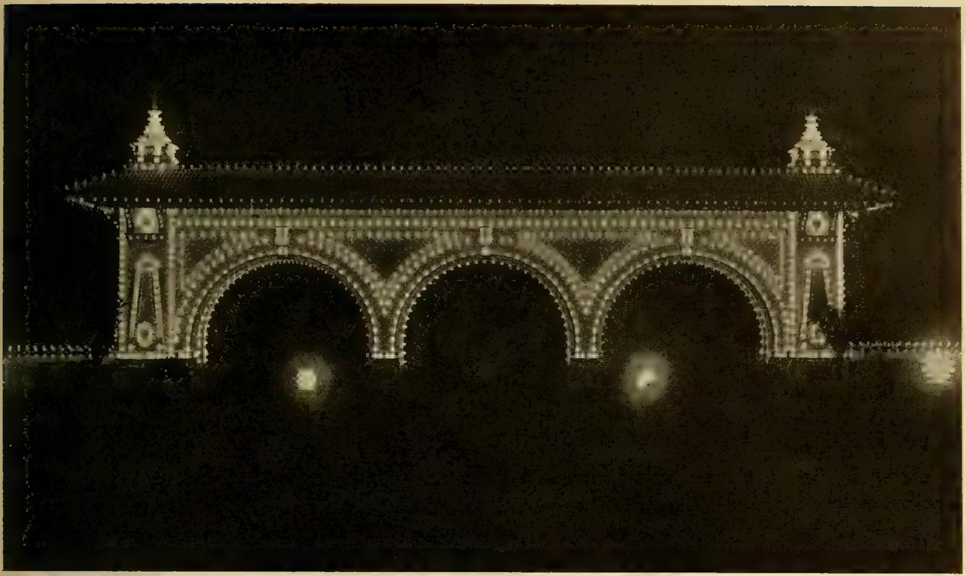


FIG. 2.—MAIN ENTRANCE.

art in itself; the basis of the art is the preservation by night of the architectural elements which are shown in the structure by day.

An interesting study illustrating this point is shown in Fig. 1, which is a view of the European Building. This building is located near a pond or lagoon, which affords a perfect reflecting surface. The light reflected by the structure itself, however, is not sufficient to affect the photographic plate, so that the image in the water is of the lights only. Turn the picture upside down, and see how much of an idea of the structure you would obtain from the outlining by the lamps.

FIG. 3.—ORIENTAL BUILDING.

Fig. 2 shows the main entrance. The numerous points of light here harmonize particularly well with the Moorish treatment of the architecture.

The Oriental Building is shown in Fig. 3. The lamps placed in the dental courses of the frieze and cornices are effective.

The Music Pavilion, shown on the front cover, is given an entirely different treatment, the illumination being confined to the interior, which, being open on all sides, gives somewhat the appearance of an enormous lantern. The result is both novel and effective.

The Lighting Expert as a Decorative Artist

By George Pugh Smith.

With the general acceptance of illuminating engineering as a science by central stations and consumers alike there has come a widespread tendency toward the decorative lighting of interiors, as well in mercantile establishments as in residences. The illuminating engineer, especially in the smaller plants, has come to be regarded more as an expert in the handling of light-sources than as a specialist in cost-saving; and to him there has usually been turned over the difficult problem of overcoming with light all kinds of architectural monstrosities.

Many a young solicitor or engineer, making his first attempts at scientific illumination, has been brought suddenly to a dead halt by having a particularly bad architectural or decorative feature to overcome and has lost the confidence of his customer by repeatedly failing to produce a pleasing effect with the range of lamps at his disposal. It may be that a residence is to be illuminated with a view to keeping the light in harmony with its surroundings, and the budding expert is met by the problem of how to overcome what seems to him an unsurmountable obstacle—the blending of room uses, light and fixtures; the even distribution of light over a bad spot; the maintaining of an inconspicuous individuality for a painting, vase or piece of furniture—and he fails to make good his claim to scientific recognition for his new science.

Or, again, a building is to be outlined in light; its exterior is as ornate as a soap box, yet a new building of fire must be placed on its face. Then the young man who has not had a great deal of experience is thrown back for ideas on the architect, the professional decorator or, worst of all, on his own draughting force. If, on the contrary, the young light expert had a working knowledge of the principles of architecture, of design, of applied decoration, how easily he could overcome the mole-hills which, to his lack of knowledge, seem towering mountains.

In the store his understanding of decoration as applied to architecture would readily have suggested such remedies as the arching with lights of a well; the latticing and festooning of an unnecessarily high spot in a ceiling; the changing of a color to a tone, or vice versa; and with his technical knowledge of the efficiency of his lamps and reflectors, his measurements and deductions would have produced the effect his promises in the name of his new science had led his customer to expect.

In a home the careful study of a room for balance in color and design or layout; the changing of a paper; the necessity for subduing or hightening the relative value of his fixtures; the using of light-sources purely as an illuminant, or as the sometimes necessary "spot"; the knowledge of the decorative value of a painting under intensified light or a colored vase; of a table and colored "port-table" properly placed; the artistic illuminating possibilities of a dimly lighted "nest" or window seat—all would make his boasts for his profession more easy of execution.

Think for a moment of the old days, at which we are all so much in the habit of smiling; when a room was designed its lighting appliances were made a part of it. The word "period" as applied to decoration was unknown, and yet usually the fixture was in perfect keeping with the room, as were the colors, furniture and

drapery. Good taste was the prime requisite, and to it were subjected all other details.

How much more necessary it is for the man who claims to handle scientifically the modern, intensely powerful light-sources to have a working knowledge of the laws of harmony, balance and color. The lights of to-day, and more particularly the incandescent electric lamp, are of themselves of distinct decorative value, if handled correctly; if misused they are the producers of more trouble and dissatisfaction than all the agents used in modern building put together. Their many forms allow of almost endless variations by concealing, frosting, coloring and directing of their gathered rays. The electric lamp particularly can be adapted to any form or demand of modern illumination. By its proper use a quiet individuality can be given any desired object in a room without throwing that object into striking relief against its neighbors. Or, again, a bad architectural feature can be almost obliterated by a blaze of lights from a decorative frieze. Whole rooms can be changed from intensely bad to handsome dwellings; houses remodeled with no other additional cost than a few lines of wiring, or changing of furniture or wall-paper; new buildings of light can be constructed on barnlike structures; and the end is not yet.

Illuminating engineering is dealing with light not only as LIGHT, but as an agent FOR INCREASING HUMAN COMFORT. Kilowatts, lumens, foot-candles and reflectors will not beautify rooms or pictures when marred by too much or too little light. Therefore it seems almost vital to the success of the new science that the younger members delve a little into the theory and practice of the art of beautifying.

The master minds who have raised illuminating engineering to the rank of a science were actuated by the knowledge of how essential beauty is to light, and light to beauty; and these men, by combining artistic with scientific principles, have swung lighting from the guesswork class into a great, promising profession, whose results will be greater comfort for humanity by keeping light nearer to the ideal of the "eternal fitness of things" and the spread of good cheer.

If, then, illuminating engineering is to succeed it must do so by its own capabilities and not by falling back for aid on the architect or the professional decorator; and it lies in the hands of the younger members to make the profession a success by learning how to use light artistically by mastering the great principles of applied art, rather than by shortsightedly sticking to consumption, energy, reflection lamps and efficiency alone.

Street Illumination by Metallic Filament Lamps and Ornamental Lamp Posts

By Dr. L. Bloch.

In the issue of The Illuminating Engineer for March (page 6) there is a description of the illumination of the principal street of the city of Minneapolis by means of tungsten lamps, placed perpendicularly on ornamental lamp-posts and enclosed in globes. On page 13 of the same issue there appeared a critical note concerning such arrangements. The note refers mainly to the architectural form and more or less pronounced purity of style of the ornamental lamp-posts.

The object of the present essay is to treat this form of illumination from the viewpoint of illuminating engineering, the viewpoint nearest to the interests of the readers of this paper. From this viewpoint the system described, which seems to enjoy singular popularity in America and is being installed in many places, appears to me to be entirely irrational. My first objection applies to the unavoidable vertical arrangement of the lamps. A glance at the distribution curves of any incandescent lamp will suffice to convince anyone versed in the art that for street illumination a downward position of the bulb is the only one to be con-

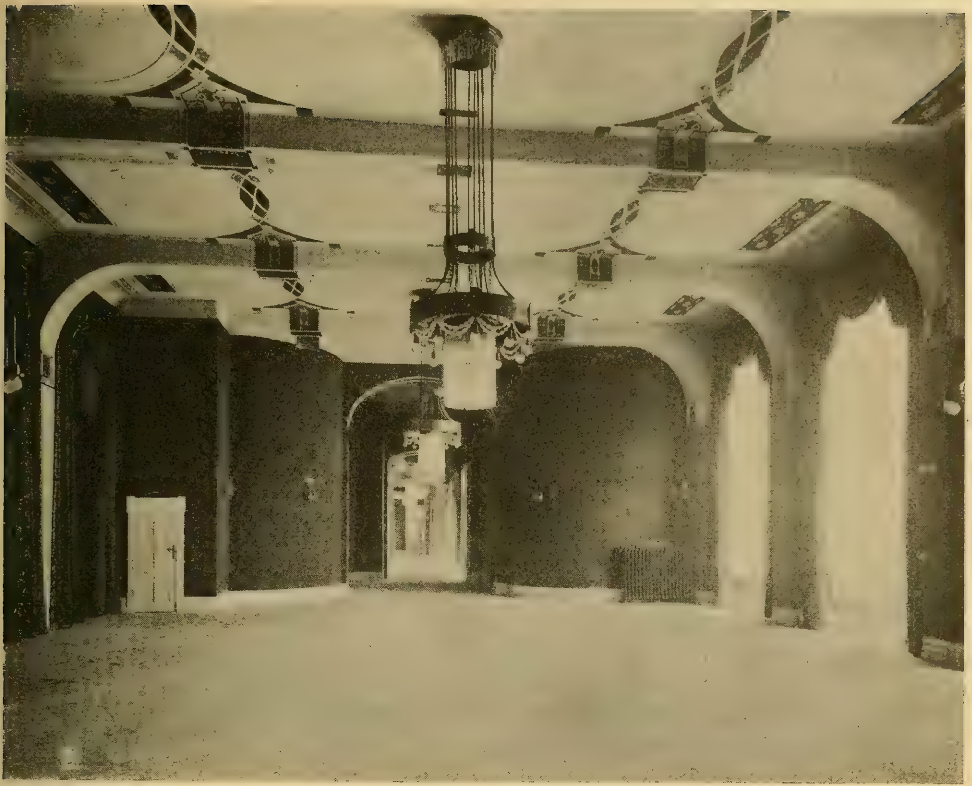
sidered. This is due to the fact that considerably more light is radiated in the direction of the lamp end than in the direction of the holder. Rationally built lamp arrangements of this type may be supplied with reflectors, allowing the utilization of the upwardly directed light for street illumination. However, in the system described, such a correction is impossible. Moreover the rich ornamentation of the lamp-posts themselves obstructs a considerable part of the downwardly directed radiation. Furthermore these systems of street illumination require the use of strongly diffusing and consequently strongly absorbing globes in order to direct the upward illumination at least partly downward. This, of course, again entails a considerable loss of light. For a rational street illumination system with incandescent lamps only clear glass globes, or at least only slightly opalescent globes, may be recommended.

The diffusion of the light furnished by metallic filament lamps by means of special globes is to be recommended for interior illumination; but the case is different when street illumination is concerned. The public demands of street illumination a more brilliant light, as it is not in the least disturbing to the eyes. This is the reason why, in general, light from satisfactory and quietly burning arc lamps is preferred to equal illumination with incandescent lamps. It has not been thought necessary in street illumination by incandescent gas lamps to use diffusing globes, and tungsten lamps may likewise be used for street illumination with clear globes. Due to the diffusion of their radiation by densely opalized or alabaster globes, the illumination acquires an uncertain aspect and dull tone, reminding one of the old fashioned gas illumination. All the defects mentioned have a cumulative effect, and require for their rectification a nearly double expenditure of energy in comparison with a technically correct arrangement.

The system in question is not only wrong in respect to efficiency, but likewise on account of the increased difficulty of handling and trimming. The ornamental parts of the posts render the lamps and globes difficult of access and increase the labor of cleaning and replacement. Although tungsten lamps may be made to run in the inverted position without trouble, they certainly give better satisfaction when used in the customary downward position.

Finally, the globes are in no way protected from soiling by deposition of dust and dirt and contamination by the rain water, which in its turn increases the difficulty of cleaning. In the ordinary downward arrangement of tungsten lamps the reflectors furnish considerable protection against dirt. The system of illumination here criticised owes its origin obviously to ancient traditions and classical antecedents. For illumination by candles, petroleum and even gas such an arrangement of lamp-posts may be, to an extent, justifiable; but there is no reason why it should be used in connection with electric illumination. Where the technical requirements are different the architect and fixture designer have to adjust and create new forms of beauty pleasing the eye of the observer.

That such a system of street illumination should find such a wide adoption in America, while it is practically never attempted in Europe, is the more astounding, as there is usually a greater inclination to follow traditions in the Old World than in the New. As long as the system was limited to carbon lamps the system may have been considered as an exception; but the high efficiency of the metallic filament lamp adds significance to this system of illumination and justifies a more critical attitude from the standpoint of illuminating engineering. The object of this contribution is to point out the fact that artistic street illumination will have to be adjusted to the technical requirements of the new illuminants to a greater extent than in the past.



YELLOW SALON AND VESTIBULE.

Berlin Ice Palace

The Berlin Ice Palace, which is to be opened the coming fall, is the largest and most modern institution of the kind in the world. The building covers an entire city block. The chief feature is the ice skating rink, which will accommodate 1500 skaters, while the galleries will seat 3000 spectators. The building also contains a large restaurant, gymnasium, baths of all kinds, besides the enormous refrigerating and lighting plant. Such a building is naturally one of the show places of the city and its lighting is therefore of special interest.

The installation consists of both arc and incandescent electric lamps, besides mantle gas lamps. The fixtures are either of bronze or wrought iron, and large use is made of glass ornaments which suggest icicles. The illustration gives a fair idea of the general character of the lighting fixtures and decoration, the room shown being the foyer to the skating rink. The fixtures contain each an arc lamp in the center encircled by glass pendants in the form of icicles. Both the fixtures and decorations are distinctly Teutonic and of the modern school.

The Germans evidently do not have the objection to placing arcs and incandescents in juxtaposition that generally prevails in this country. This installation is not an exception, but represents a somewhat common practice in large interiors. The use of arc lamps where the decorative feature of the fixtures is important is another feature differing from the usual American practice.

DENVER LIVE STOCK AUDITORIUM.

The Lighting of the National Live Stock Auditorium of Denver

By Ross B. Mateer.

The National Live Stock Auditorium erected by the business interests of Denver, Colorado, marked an era in Denver's growth. For some years it had been the custom to have an exhibition of live stock, but lack of proper facilities to show the stock prevented Denver taking the place which she, as a leading city in all industries, was entitled to claim. In 1908 it was determined to erect an auditorium for the exhibition of live stock which should be unexcelled by any other in the country. Accordingly such able men as Col. W. E. Skinner, of Chicago and Denver; Geo. Ballantine, A. H. Veeder, Jr., and other prominent Denver business men set about the fulfillment of this idea.

To-day, at the stock yards, is found a mammoth building of steel, brick and concrete, 294 feet in length and 202 feet in width. The arena is 189 feet in length and 97 feet in width. Surrounding the arena are tiers of seats, capable of seating 6200 persons.

The proper lighting of this structure was a problem with which the illuminating engineering department of the lighting company was entrusted. Bearing in mind that no shadows were permissible and that a uniform light over the entire arena was demanded, a system of lighting was designed which not only pleased the local interest, but elicited many complimentary remarks from those familiar with the lighting of large auditoriums in other cities.

Twenty-eight flaming arcs were suspended from the roof at proper locations, and so arranged that they might be readily lowered for retrimming. Surrounding the arena and over the seats were placed twenty-eight clusters, each of three 100-watt tungsten lamps, so arranged that while the audience were assembling only the tungsten lamps would be used. After all were seated the arcs were switched on and the tungstens switched out, obtaining a very brilliant illumination.

TEXAS STREET, SHREVEPORT, LA.

A Southern Instance

Shreveport, La., has awakened to the advantages of spectacular lighting. Texas Street, its main thoroughfare, is illuminated with 1000 eight candle-power lamps in festoons, as shown in the accompanying cut. Each festoon contains 50 lamps. This, together with a large number of electric signs, it is claimed, makes Shreveport the best lighted city of its size in the South. The merchants paid the cost of the installation, and contribute $1 per month each for maintenance. The lamps are burned regularly only on Saturday night; but on special occasions, as during the recent street fair, they are in service every night, the central station making a low special rate for such purposes. The lamps are run in multiple on 110-volt alternating current, a switch being placed on each pole.

Modern Street Illumination by Metallic Flame (Luminous) Arc Lamps

(Concluded.)

By G. Brewer Griffin.

Several years of experiment have proven that oxide of iron in one form or another is the best material for use in the negative electrodes, although not as efficient as might be desired as a light producing agent; but it is a good conductor and maintains a stable arc at all temperatures. The performance of iron oxide is similar to that of carbon in the flame carbon lamp, as it furnishes a conducting vapor

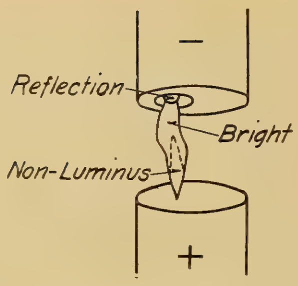


FIG. I.—WESTINGHOUSE METALLIC FLAME ARC.

and its low light producing qualities are offset by the addition of titanium, which makes the flame of the arc highly luminous. Other materials are also used in combination with these two, such as chromium oxide, to restrain the rapid consumption of material by evaporation, and still others which tend to flux the metals together.

While the positive electrode in this type of lamp is in some cases copper, the writer's observations would tend to show that certain copper alloys, or copper and pure iron work the best. This electrode should be of sufficient size to properly radiate the heat, and of such a quality that its oxides when fused into a slag will be a good conductor when cold. One lamp now on the market, which has a down feed negative electrode, gives a life of 225 to 250 hours with about 10 inches of active material and produces a uniform white light of very great brilliancy, and at the end of the period named shows very little deposit in or on the globe, owing to the method which has been evolved for proper ventilating the lamp and conducting the oxides formed by combustion outside the lamp and in the metal chimney which the lamp has. In this type of lamp a larger portion of light comes from the flame, as before mentioned, therefore the arc produced can be compared to the candle flame, which has a luminous and non-luminous zone. (See Fig. 5.)

The luminous zone is near the negative electrode and consists of a hollow cone-shaped mantle of volatilized oxides of titanium. Now since the electrodes of the metallic arc contain the oxides of metals the vapors deposit as a solid and therefore the successful operation of such a lamp depends almost entirely on the effectiveness of the ventilating system which will remove these fumes from the lamp. Fig. 6 shows a successful method of doing this. As before mentioned, the type of lamp herein mentioned has the electrodes arranged vertically, the upper electrode being the negative.

Reference to Fig. 7 shows the characteristic distribution of the light which adapts it particularly for street illumination. The lamp is operated with an arc length of approximately ½ inch; voltage drop across the arc, 66; across the lamp, 68, and has a current flow of 4 amperes. The efficiency of the arc is approximately 0.88 watt per mean spherical candle power and 0.44 watt per mean lower hemispherical candle power. Compare this with the inclosed carbon arc and it will be observed that the lamp has fully 50 per cent. more burning hours per trim and approximately three times the efficiency.

The suitability of a lamp for the purpose for which it is intended is a vital factor in making the selection of any lamp. Some lamps are limited in their application on account of color defects, such as the Cooper-Hewitt mercury lamp or the impregnated carbon flame lamp, which, although they are lamps of high efficiency, could not be used for purposes which a lamp of lower arc efficiency would be selected.

Reference to the light distribution curve of a metallic flame lamp shows that the light intensity is fairly uniform at a point from 10 to 30 degrees below the horizontal. This permits the hanging of lamps so that the arc is above the direct line of vision, eliminating visual effect

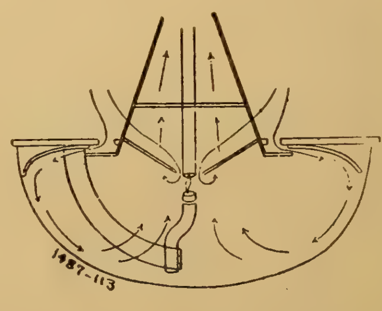


FIG. 2.—PATH TAKEN BY AIR CURRENTS IN A WESTINGHOUSE METALLIC FLAME ARC.

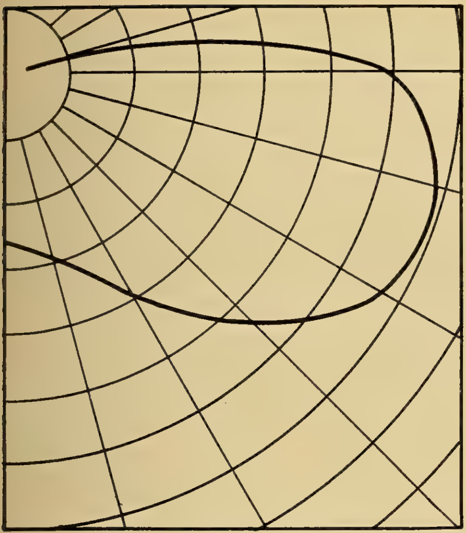


FIG. 3.—TYPICAL LIGHT DISTRIBUTION OF A WESTINGHOUSE METALLIC FLAME ARC—4 AMP.

due to direct glare from the arc and at the same time giving a more nearly uniform surface illumination in the street. In a number of instances metallic flame arc lamps, 266 watts at the arc, have successfully replaced 7.5 ampere series A. C. inclosed carbon lamps consuming 455 watts at the arc, on account of the fact that the maximum light intensity of the metallic flame lamp is near the horizontal and of such a value as will give twice the illumination between lamps as is given by the inclosed carbon lamp. Thus we are back to the first proposition; that is, if an existing installation of inclosed carbon lamps is replaced by an equal number of metallic flame arcs the city is greatly benefited by a much superior illumination, while the central station is under considerably less expense so far as the supply of energy is concerned.

The American people are a self-satisfied race, which probably accounts for the fact that the lighting of our cities does not compare favorably with that of European cities of equal size. The need for better lighted city streets has in the last year become recognized by business men's associations in certain large cities, these associations taking it upon themselves as a business investment to supply additional arc lamps on business streets, as they recognize that light is the best advertising medium known and that trade will be attracted to streets which are well lighted in preference to those who are only moderately well lighted. The metallic flame lamp fits in exactly with the present demand in this direction, giving larger units of light with improved color values, and better general distribution. Some central stations are successfully using the metallic flame lamp to compete with gas arc lamps which are used outside of store entrances.

Some years ago before the advent of the series A. C. inclosed lamp the only method known for successfully operating arc lamps was from direct current series arc machines, which were admittedly of very low electrical efficiencies. In addition to this, other losses were incurred owing to the method of belt driving, countershafts, etc. The advantage of the series A. C. carbon lamp, with its constant current regulating transformer, made possible a higher central station efficiency and a much simplified arrangement which the up-to-date central stations were quick to avail themselves of by adopting the series A. C. arc lighting apparatus. As this has been so generally adopted and so well liked from the viewpoint of the central station operator, so far as the generating apparatus is concerned, it is necessary with the metallic flame lamp, which is distinctly a direct current proposition, to operate the system from alternating current generating apparatus. The research work done by Mr. Peter Cooper Hewitt brought forth the mercury rectifier, whose function is to suppress a certain portion of the A. C. wave and produce what is in effect a pulsating direct current. One of the applications of this device is to use it in conjunction with a regulating transformer, enabling direct current lamps to be operated from alternating current generating apparatus.

There are three different forms of modern arc lighting circuits and their approximate efficiences, which are, roughly, as follows:

	Per cent.
With arc machines driven by motors..	66
Series A. C. with constant current regulating transformers from A. C. supply circuits.......................	90

A. C. supply with regulating transformers and Cooper Hewitt arc rectifiers 88

In considering these efficiencies (which are the efficiencies of the systems) the saving in the wattage per lamp without a corresponding reduction in the amount of light produced must of course be taken into consideration, as on this depends the real value of the system. The metallic flame outfit occupies the minimum amount of floor space, works upon the static principle and requires very infrequent attention. In addition the metallic flame system can then be operated from 25-cycle circuits, which are common with transmission and railway plants and companies supplying energy strictly for power purposes, and as good operation obtained as on 60 cycles. This cannot be accomplished with series A. C. carbon lamps.

I have not undertaken in this article to go into the comparative maintenance costs, but figures are available which show that the metallic flame system can be maintained at a cost not higher than that involved in the maintenance of series A. C. carbon outfits, and in some cases considerably lower.

It is only fair to prophesy that the result of the past eight or ten years' research work promises that in the next period of similar duration lamps of still higher efficiency will be produced, as we must bear in mind that the mechanical equivalent of a white light is about 0.07 watt per candle; but so far as can now be seen, it will be some years before a system will be developed which will show very much improvement over the present metallic flame arc lamp system. The inclosed carbon lamp will still have its field, as will the impregnated carbon lamp, as they will still be installed in interior work where the fumes from the metallic flame arc and the by-products which it throws off are an objection; but the great advantages of the metallic flame lamp are found in its high efficiency as a light source, its low maintenance cost, long life per trim, practically ideal light distribution curve for street illumination, the so-called white color of the light and the ability of the lamp to operate with a considerable light volume with small current values, and it is fast displacing all other types of arc lamps for street illumination.

It should be noted that the lamp will operate quite as well from a good constant current arc machine, if it is rewound for the proper amperage and the user is willing to put up with the resulting inefficient operation of this type of generating unit.

Distance Control of Gas Street Lighting in England

By James A. Seager.

The gas lighting authorities of American cities largely depend on the old-fashioned method of lighting and extinguishing street gas lamps by hand, but on the continent of Europe considerable progress has been made in the adoption of automatic devices for the control of street lighting, and, although viewed in a certain sense this appertains rather to the mechanical than to the illuminating portion of the subject, it is difficult to draw a hard and fast line between the two components of the problem. It may, therefore, be interesting to review briefly the causes which have tended toward this practice, at any rate so far as Great Britain is concerned, and to give a summary of two or three of the systems which at the present time appear to most satisfactorily meet the conditions imposed as the result of experience in this direction.

The older style of lighting and extinguishing has two or three disadvantages which cannot fail to have been realized by those interested in the public supply of gas. The most important is that it is impossible to control the old system from a central point, and much has to be left to the honesty and discretion of each individual lamp lighter. Moreover, as in Great Britain at any rate the number of lamps under the charge of each lighter varies from, say, sixty in the smaller

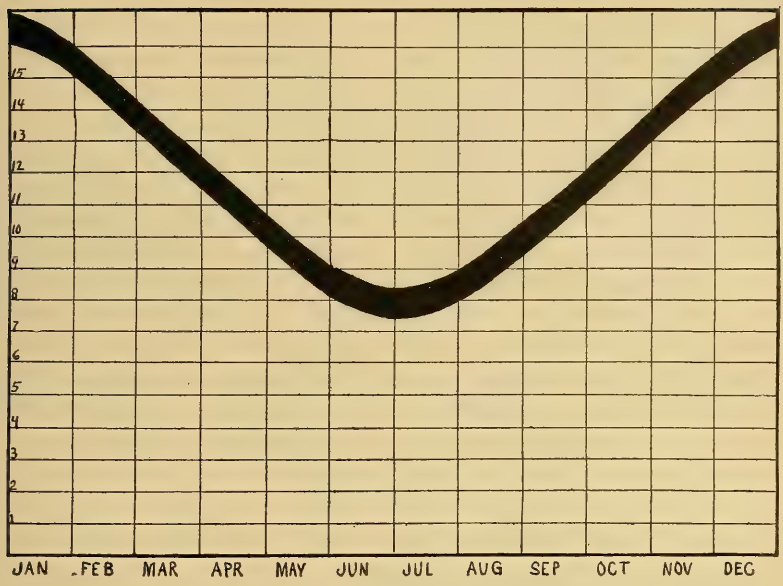


FIG. I.

towns to 120 in the longer beats in large towns, it is impossible to obtain simultaneous lighting and extinguishing. It may be safely allowed that the average time taken by a lamp lighter from the moment when he starts on his rounds to the time when he finishes his last lamp is not under one hour, and the result is that either the conditions as to keeping lamps burning between sunset and sunrise are not strictly observed or else a considerable amount of gas is wasted at each end of the burning period. Fig. 1 illustrates this diagrammatically. In this are shown vertically the hours of darkness for every period of the year at the longitude of the British Isles, and, therefore, the area enclosed between the two vertical lines and the horizontal base, together with the lower edge of the black band, may be taken as a measure of the amount of gas burned throughout a year on any system which could instantaneously light and extinguish all its lamps at sunset and sunrise. With the old system of lighting this is impossible, and assuming that the lamp lighter starts an hour before sunset to light up and finishes extinguishing an hour after sunrise the average loss of gas per day would be represented by one hour's burning of each lamp multiplied by the number of lamps in the area. Therefore, the whole area covered by the black band in Fig. 1 represents the waste of

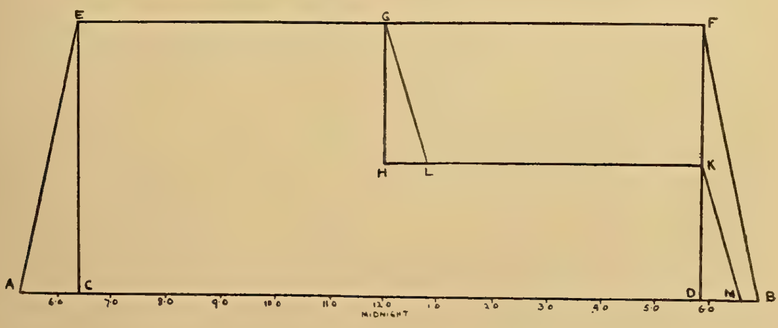


FIG. 2.

gas throughout the year due to hand lighting to the same scale as the gas above mentioned. Assuming that all the street lamps are burned from sunset to sunrise throughout the year, it will be found from the diagram that 7.8 of the total quantity of gas throughout the year is wasted, which is by no means an inconsiderable figure.

The argument may, however, be carried a little further. It will be found on averaging the ordinates of the curve in Fig. 1 that the average day in Great Britain contains about 11 hours 15 minutes between sunset and sunrise. Fig. 2 shows the state of affairs in March 27 of this year. Sunset occurred at 6.21 p. m., and sunrise at 5.51 a. m., giving 11 hours 30 minutes darkness. This is sufficiently near to the average value to enable us to obtain a fair deduction. If in Fig. 2 the line E. C. represents the amount of gas used at any instant of street lighting, the rectangle C. E. F. D. is equal to the total gas used during the night after all lamps are alight throughout, but as above mentioned each lamp lighter will take approximately an hour to go round his beat in order to light up his lamps and another hour to extinguish. The consumption of gas during these periods is, therefore, represented by the area of the triangles A. E. C. and D. B. F. The total consumption of gas is, therefore, shown by the area of Fig. A. E. F. D., and the percentage of saving gas by automatic lighting and extinguishing, assuming this to be instantaneous is, therefore:

$$\frac{\text{Area A. E. C.} + \text{Area D. B. F.}}{\text{Area A. E. F. B.}} \times 100.$$

in this case the figure is 8 per cent.

Another point is that in many areas half the lamps could be extinguished after midnight, the remaining half burning until dawn. It is hardly practicable to do this by hand, as the lamp lighters would have to go around their beat three times daily. Even assuming this possible the bulk of the time taken in extinguishing is occupied in walking from post to post, and a round could not be done in less than three-quarters of an hour, extinguishing only half the lamps. The gas used at such times is shown by triangles G. H. L. and K. M. D. and the total gas used will be represented by Fig. A. E. G. L. K. M. The percentage saving by automatic extinguishing would, therefore, be

$$\frac{\text{Area A. E. C} + \text{Area G. H. L.} + \text{Area K. M. D.}}{\text{Area A. E. G. L. K. M.}} \times 100$$

equaling in this case about 9.7 per cent.

But, owing to the impracticability in most cases of turning men out at midnight to extinguish half the lamps a fairer comparison is between the automatic extinguishing system putting half the lamps out at midnight and the hand system leaving the whole of the lamps on till dawn, i. e., the percentage saving being

$$\frac{\text{Area A. E. C.} + \text{Area G. H. K. F.} + \text{Area F. B. D.}}{\text{Area A. E. F. B.}} \times 100$$

or about 30 per cent. saving, which is an item worth consideration by every gas engineer. Added to this there is the consideration that a huge saving of wages of lamp lighters is effected. In Glasgow, where there is no intention of spending money needlessly, each lamp lighter receives £67 12 0 per annum for looking after 118 lamps; in London under the lighting department of the Gas Light and Coke Company, each man lights eighty lamps by torch; at Bath, a representative provincial city, each lamp lighter looks after sixty lamps, and there is no doubt that in every commercial type of automatic controllers, whether operated by means of clockwork (which may require periodic setting and adjusting) or by means of a wave of pressure from a central source, an immense saving of wages is effected. It is not the intention here, however, to enter minutely into financial considerations, and beyond saying that the types of automatic controllers on the British market range from about 30 to £2 per lamp, the money part of the question will not be further regarded in this article, especially as prices both for apparatus and labor vary so much in the old country and the new. It may, therefore, be interesting to mention representative types of automatic gas controllers which have found their way into public

favor in Great Britain. These may be divided into two classes; first, those which depend on clockwork for their operation, and, second, those which are operated by a temporary increase in gas pressures. Both systems have their adherents, and it will be advisable to briefly summarize some of the points which have been raised on both sides without attempting a conclusion.

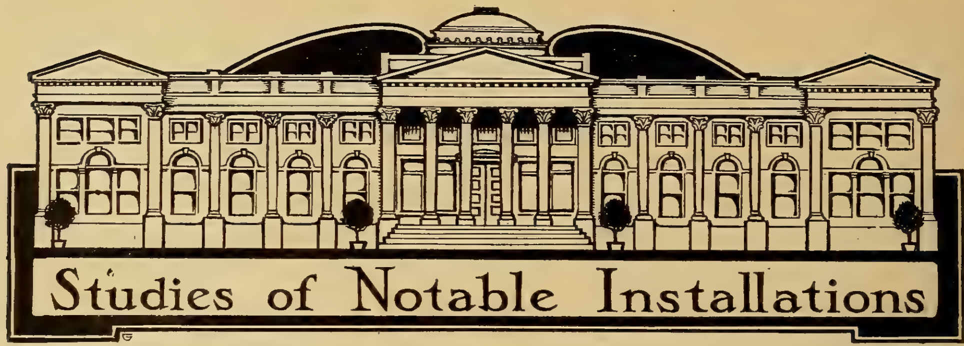
Clockwork devices require periodic resetting of time, both as to the hour of extinguishing and the hour of lighting; this, however, can be effected by the lamp cleaner during his ordinary circuit. They have another feature, however, which is perhaps a little more serious in cities such as London, which are occasionally visited by dense fogs; this is, that as the the times are definitely fixed for a certain period until the next resetting, it does not matter how dark it may become at mid-day owing to fog, the lamps will remain unlighted, and there are no means of controlling this from the gas works, except by organizing an emergency gang to turn on the lights by torch, an almost impossible proceeding.

To a smaller extent this disadvantage is apparent in most towns subject to dark and light evenings, the fixed time being in most cases a disadvantage. On the other hand the automatic system of lighting by means of a gas pressure wave has been objected to on the ground that such an increase for however short a period may interfere with consumers having gas fires and gas cookers, and also with the bye-pass of private installations. The old-fashioned water seal is rapidly passing out of use in Great Britain, which is a matter for considerable thankfulness; where, however, they are still present there is a danger of the pressure wave blowing the water out of the seal and starting an escape. It will also be found that in a gas supply system of any magnitude there are surges of gas pressure which are independent of this installation transmitted from the works. For example, in the case of fog a large number of private houses will put the lights on, and should this fog clear off suddenly these will be extinguished equally smartly. Over a long main, a rise of pressure due to the sudden check will immediately be felt, with the result that, should this rise reach the limits of the operating movements of the automatic control, the natural sequence of events in the lamps will be reversed, and they will light up during the hours of light and be extinguished during the hours of darkness, until they are attended to individually and put on the right sequence again.

Without entering too deeply into such a controversial subject, however, it may as well be stated that automatic gas lighting of street lamps is being experimented with, and adopted on one principle or another by almost every public gas lighting authority of any magnitude in Great Britain.

The "Gunfire" controllers, which will be mentioned later, are in use to the extent of considerably over 30,000 throughout the country. At Folkestone, for example, over 1000 have been adopted, after trials extending over two years, while Bournemouth started with 150, extended to 560, and has now 1160, while Oxford commenced with 60 and has now 1500. The "Rostin" controller, which is of the pressure control type, is being used extensively in the London area. The Gas Light and Coke Company in London, after having made three consecutive installations in the boroughs of Lambeth, Westminster and Battersea, have decided to extend the "Rostin" apparatus to the whole of the Westminster, Lambeth and Southwark districts, comprising over 3200 lamps. Also the Tottenham and Edmonton Gas companies have decided to have the "Rostin" apparatus fitted throughout the whole of their districts, covering sixteen square miles, and comprising 5000 lamps, while in Liverpool a preference is shown toward the "Horstmann" controller, which is self adjusting as regards lighting hours, and merely require weekly winding. A type of distance pressure lighter which is now making headway in Great Britain, but which has its chief strength on the continent, is the "Bamag." Taking the figures for the whole European area up to Nov. 1, 1908, no less than 28,000 "Bamag" controllers have been supplied up to over 200 towns.

(To be Continued.)



The Y. W. C. A. Building, East Fifteenth Street, New York City

A thing may be notable for faults, as well as for virtues. If all the bad lighting installations were to be remodeled on illuminating engineering principles within the next ten years, illuminating engineers, electrical contractors, and gas fitters would enjoy a financial millennium. There is many an installation at the present time which reminds one of the clothing of the oldest boy of a large but poor family, who has developed too fast for the resources and tact of the well meaning but overworked housewife to keep up with him, and whose garments show the various discrepancies and abbreviations marking the different epochs of his evolution; the long trousers that superseded the knickerbockers fail to connect with the tops of his shoes, and the coat seems to have shriveled up from chagrin at not being able to meet its obligations as to length of sleeve and breadth of chest. The means of producing artificial lighting have advanced with exceeding rapidity during the past twenty-five years, and have in many cases left the old methods for its utilization in a state of decrepitude and misfit; there are often evidences of an effort to fit the garment to the growing boy, with the usual bizarre results.

The building chosen for review in this article is not taken as an individual "horrible example," but as a type to illustrate a large class. It is devoted to the usual purposes of such organizations—namely, for social gatherings, and for night and day classes in various practical studies. Space will not permit the illustration of all the rooms, but those shown are fair examples of the general installation.

Fig. 1 shows the rooms used as a restaurant. It will at once be observed that very considerable and successful efforts have been made toward the artistic structure and decoration of these rooms. The ceiling is handsomely paneled, and the large fireplace is excellent, as in fact are the decorations in general. Surely this room calls for a method of lighting in keeping with its artistic merit. Whatever else may be said of the cluster of bare electric lamps under the single large reflector, no one will claim for it a primarily artistic value. Its presence is evidently the result of a desire to get "something better" than the old system, which was evidently the conventional combination gas and electric fixture—one of which may be seen beyond the archway. Combination brackets of similar design appear over the fireplace and on the side walls. That the electric illumination was an afterthought is shown by the presence of molding wiring, and by the use, to an unwarranted extent, of flexible cord. This should furnish an impressive example to the gas people of a lost opportunity—and there are hundreds of thousands of others of a similar character. Evidently the original installation of gas and electric light proved to give inadequate illumination; the thing to be done was then to "string up" some additional electric lamps. The phrase just expresses it; there was no thoughtful con-

FIG. I.—RESTAURANT.

FIG. 2.—TYPEWRITING CLASS ROOM.

FIG. 3.—DRESSMAKING CLASS.

sideration or careful calculation as to what lamps and reflectors would be best suited to the purpose, nor where they should be put; the electric wireman came in and "strung" his wires and hung up electric lamps wherever his fancy dictated.

Fig. 2 plainly shows the purpose for which the room is used, a purpose which undoubtedly calls for its use at night for a very considerable portion of the time; hence the additional importance of good lighting. The combination gas and electric fixture originally installed is still in evidence. The ordinary flame gas burners are still in the place, with plain opal globes; then there are the sprawling electric arms, with lamps pointing in either direction. More light was wanted; moldings were run on the ceiling and down the side walls. Two nine-lamp clusters were hung up, with bare lamps, and a reflector safely lifted above all possibility of doing any good. A single drop cord supporting a lamp and tin shade was added, for what particular purpose does not appear. A side bracket was placed so as to project the lamps beyond the bookcase. It would be difficult to conceive a more heterogeneous and makeshift arrangement of lamps and fixtures than is here shown. The bare lamps for the bookcase shine directly into the eyes of all the pupils, while the bare lamps above finish the work of destruction of the eyes of those sitting on the back seats.

Fig. 3 is a view of the room occupied by the dressmaking class. The fixtures here, particularly the two-light electrolier in the foreground, are grotesque in their absurdity. If the dresses turned out here fit their wearers no better than the light units fit the purpose of illumination, the work of the fair pupils would be better suited to a fusilleer parade than to the reception room or ball.

Fig. 4 is a room used for sewing classes. The experiments in illumination are again varied, two different types of fixture being used, probably with the idea that one

FIG. 4.—SEWING CLASS ROOM.

should be given a choice of evils. No wonder the oculist tells us that the electric light is hard on the eyes; a bath would be hard on the body if one had to take it directly from the nozzle of a fire-hose.

Now, this installation is no better and no worse than innumerable others; it is inefficient, uneconomical, ugly in appearance, and injurious to the eyes of those using it. The reason for its existence can be given in a single word—ignorance; not willful ignorance, but simply the ignorance of neglect. The reason that would probably be given by those responsible for it would be that they could not afford anything better. The fact is, however, that, as compared with a modern installation put in on illuminating engineering principles, the present one is the height of extravagance. The results are unquestionably bad, both as to quantity and quality, and the expense of maintenance more than enough to furnish a thoroughly satisfactory lighting system. All that is needed here is knowledge, the application of illuminating engineering, and the expenditure of a comparatively small sum of money, which would be repaid undoubtedly in less than a year from the savings effected. Either gas, electricity, or a combination of both can be used to give satisfactory results.

Who will be the first electrical contractor, or gas fitter, to convince the managers of this building that they can get modern illumination, save the association money, and protect the eyes of its patrons?

Fixtures and Accessories

Brackets

So long as there are side walls there will be brackets. The illuminating engineer, particularly the novice, is rather given to decrying the use of bracket lighting, but it has its purposes, which it accomplishes in a manner that cannot be equally well secured by any other means. The theoretical objections to the bracket are its lack of efficiency on account of its position and its location, usually more or less in the direct line of vision. To the former objection the answer may be given that a position on the side wall is the only one which will give the brightest illumination around the outer portions of the room, both on the floor and walls, and this may be an essential quality in an illuminating scheme; as, for instance, where it is desirable to even up illumination from a central unit used to light a large area. The second objection may be met by the claim that a well-diffused light reaching the eye from a low angle is much less trying than a light of equal intensity given out from a high angle.

Besides having these utilitarian advantages, a wall bracket is also frequently called into requisition as a decorative element, to relieve a too wide expanse of wall space or to furnish a real or apparent source of illumination where the other sources may be wholly or in part hidden from view. An instance of what may be accomplished by bracket lighting, even in a large space, was shown in the illumination of the Maxine Elliott Theatre, described in a recent issue.

From the engineering standpoint there is one hard and fast rule which must positively be observed in all cases of bracket lighting, and that is to screen the light-source completely by means of diffusing globes, gas flames used with imitation candles excepted. To put up a bare electric or incandescent gas light on a bracket is an outrage alike against art and hygiene, and is under no circumstances to be tolerated.

The artistic treatment of brackets offers a fairly large range for originality and effect, although naturally not so broad as that of the chandelier. Brackets are ordinarily, and always ought to be, placed at least approximately within reach of the hand; thus being seen at short range, they can be given greater elaboration of details than is admissible in chandeliers, which are often far from the point of vision.

FIG. I.—SIMPLE BRACKETS.

FIG. 2.—INVERTED GAS LAMP BRACKET.

If their possibilities for decorative treatment are somewhat less, they possess the compensating advantage of offering less opportunity for ugliness. The simplest form of bracket is simply a "canopy," or wall plate, a short piece of tubing, either bent or furnished with an angle fitting and supplied with either a single gas or electric lamp, as shown in Fig. 1. Such brackets involve nothing more than the mechanical necessities, and hence are neither ugly nor artistic.

Variations from this simple form may be made in endless variety by elaborating the canopy, or wall plate, and the support. As pointed out in a previous article, a very slight variation in line or contour from the simplest forms gives an unmistakably artistic touch. This is well illustrated in Fig. 2, in which the oval wall plate and double curve of the supporting arm give a decidedly pleasing effect and quite destroy the hard, mechanical appearance of the simple forms shown in Fig. 1.

Probably the two elements most commonly used in the artistic treatment of brackets is the torch and the cornucopia, the former on account of its symbolism as well as its mechanical adaptability and the latter also on account of its symbolism and its naturally graceful lines.

Fig. 3 gives two examples of the simplest form of the torch motive. These have a lightness and grace that suit them to residence lighting. The torch is a more general favorite for massive treatment, for use in large public buildings, particularly in hallways and entrances. They are frequently fitted with opalescent globes, so as to simulate a flame. An effective design of this type is shown in Fig. 4.

The cornucopia likewise admits of substantial construction, and is hence better adapted to large interiors than to residences. The essential line of beauty of the cornucopia is the continuous curve from its small end to the flaring bell. To produce this requires that it should be cast complete, and this is naturally more expensive than simpler forms of construction. Fig. 5 shows a beautiful combination of both the cornucopia and torch elements, the latter being used as a wall plate. Attempts are not infrequently made to imitate the cornucopia by the use of tubing and spun metal parts, but these imitations not only proclaim their falsity but offend the eye by reason of their faulty mechanics. Such a construction is suggested by Fig. 6. The difference between this and Fig. 7 is sufficiently apparent.

The problem of combining a single gas

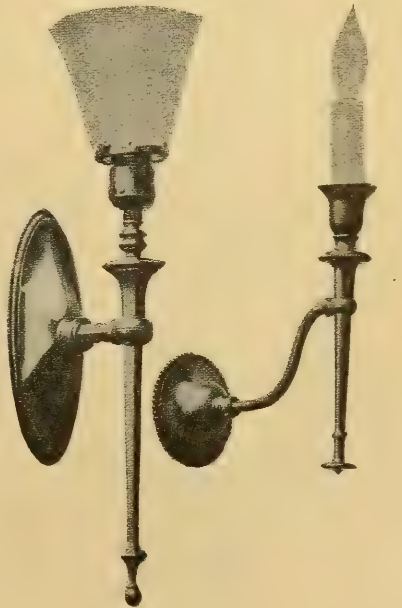


FIG. 3.—SIMPLE FORMS OF TORCH MOTIVE.

and electric light on one bracket gives rise to many perplexities, the difficulty being to keep the balance between the two light-sources. Fig. 8 shows a number of solutions of the problem. A is a simple arrangement of a gas flame above an electric lamp placed vertically. This produces a balanced appearance and is free from technical objections. In B the electric lamp is placed at an angle, which is advantageous in certain locations and does not destroy the balance. C is an attempt to place the gas back of and slightly above the electric lamp, but is scarcely successful. It is unscientific from the fact that the electric shade is directly in the way of the light from the gas burner, hence the gas burner has the appearance of being out of place. D is hopelessly out of balance, but could be made entirely successful by using one of the small mantle burners and fitting it with the same glassware as the electric lamp.

FIGS. 4. 5. 6.

FIG. 7.

Fig. 9 is an exquisite piece of workmanship and design from the Petite-Trianon. The use of the French horn for the bracket arms is highly effective.

The use of a mirror in connection with the wall plate is particularly suited to certain residence purposes. Neat designs of this class are shown in Figs. 10 and 11.

Brackets afford an opportunity for the use of other materials than metal. Exquisite brackets for residence use are produced in Dresden porcelain; glass is also available, and the possibilities of wood in connection with electric light have been scarcely touched upon as yet. There is no structural reason why brackets for supporting electric lamps should not be considered a part of the woodwork and correspond with the door frames.

FIG. 8-A.

B.

C.

D.

FIG. 9.

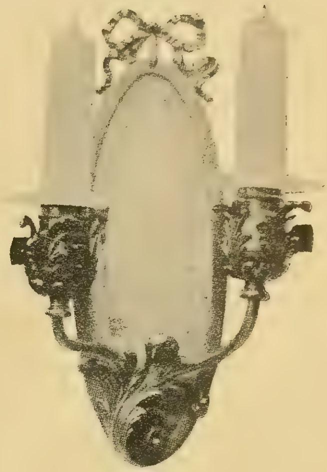


FIG. 10.

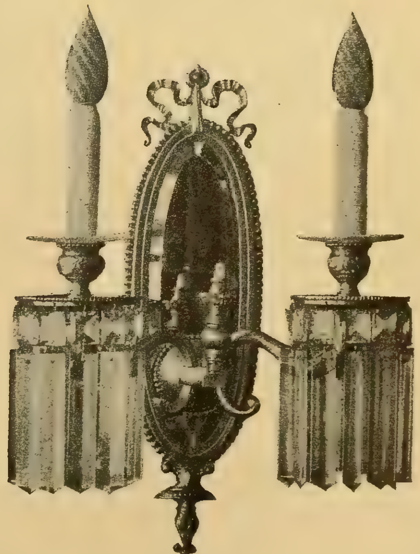


FIG. 11.

Theory and Technology

Photometry of Light Sources With Reflectors

By W. J. Cady.

There is a general idea that lamps with reflectors may be tested photometrically just as the lamps themselves would be tested, but there are certain differences which, if they are not borne in mind, will lead to grave errors, errors which concern the illuminating engineer as well as the photometrist.

Practically all photometry is based upon the law of inverse squares and, directly or indirectly, assumes a point source of light or one that is equivalent to a point source. Thus, it has been proved that for photometrical purposes the filament of an incandescent lamp may be considered as a point source of light and the law of inverse squares applied to it, provided that measurements are made upon it at a distance from the lamp of more than five times the height of the filament.* If, however, a parabolic reflector is placed about the lamp and this reflector is of sufficient size that the lamp may be considered a point source of light, all of the light will be sent out in practically parallel rays (see Fig. 1). The intensity of illumination at a point B will, therefore, be equal to that at A, only half the distance from the lamp and reflector, so that if a photometer head were placed at A and B the readings (representing illumination) would be the same. Now if the candle power of the lamp and reflector is calculated from the usual inverse square law, it will be found to be four times as great in the case where the measurement is made at B as that made at A. The dotted line shows the case of a point source where the rays are radial instead of parallel and where the circle (shown full and as an ellipse) at B is one-fourth the area of the dotted circle, the proper case for the inverse square law. If it were not for a certain amount of absorption of light in passing through the air, the intensity of illumination would be the same at a distance of one foot, ten feet, or ten miles, and, consequently, an innumerable number of candle power values might be found for the lamp and parabolic reflector.

As stated before, in the case of the theoretically perfect parabolic reflector which would have to be deep enough so that practically all of the direct rays from the light source would strike the reflector, the illumination would be the same at various distances from the reflector except for the absorption of the atmosphere. If, therefore, the illumination were measured at a point B (Fig. 1) at a conveni-

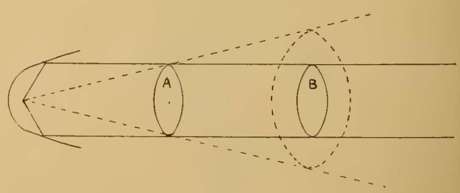


FIG. 1.

ent distance from the reflector and found to be X foot-candles, the illumination at one foot distance would also be X foot-candles. The illumination would thus be equivalent to that at one foot distance from a point source of light of X candle

* Dr. E. P. Hyde. Transactions of Illum. Eng. Soc. for Nov., 1908.

power. This equivalent candle power at one foot distance might be made the basis of rating the candle power of searchlights, and is preferable to stating the equivalent candle power at ten or twenty foot distances, which method runs into very large values and gives no means of comparing the intensity of various searchlights until reduced to candle power equivalent at the same distance.

FIG. 2.

The beams from all searchlight reflectors diverge to a certain extent (as shown in Fig. 2) and, therefore, the intensity of illumination decreases with the area of cross section. The outer rays, if extended backward, would meet at a point O, and if all of the rays met at this point this might be considered as the center of radiation and calculations based upon this point. The rays from the central part of the parabolic reflector, however, will be much more nearly parallel and would meet at a point considerably further from the reflector than O.

To measure the candle power of such a beam, illumination readings should be taken at a number of points in a plane at C at such a distance from the source of light that the readings could be made conveniently, but not at such a distance that the absorption of the atmosphere would appreciably diminish the illumination. These readings should be taken at points from the center of the plane to the edge of the plane at distances apart representing equal areas. An average of these readings will then give a true average illumination at the plane C. The area of C is then determined, and also the area of cross section of the beam at D, one foot distant from the center of radiation. The illumination at D will then be found by multiplying the foot-candles at C by the ratio of the area of C to the area of D. The equivalent average candle power of the beam will, therefore, be numerically equal to the foot-candles at D. As the effectiveness of a searchlight depends upon the parallelism of the beam, if the angle of the divergence of the beam and the area of cross section of the beam at D were given, these values, together with the equivalent average candle power, would enable one to determine the illumination at any distance from the reflector, due allowance being made for atmospheric absorption.

Although the searchlight is rather a special case, the effect of parallel rays takes place to a certain extent in the case of most reflectors, and especially is this so with concentrating reflectors. This fact is proved by a test on a concentrating reflector placed first at ten feet, and then at four feet, from the photometer disc (see Fig. 3). In the test at ten feet the end-on candle power is 29 per cent greater than that calculated from the test at four feet. Had the reflector been of the parabolic type, so that all the rays were parallel, the illumination on the photometer disc would have been the same at both distances, and consequently the candle power calculated for the ten foot distance would have turned out to have been $\frac{10^2}{4^2}$, or 6¼ times as great as for the four foot distance. Theoretically the mean spherical candle power for a parabolic reflector would be greater when tested at a large distance than at a short distance, provided, of course, that the inverse square law were used, but in the curves

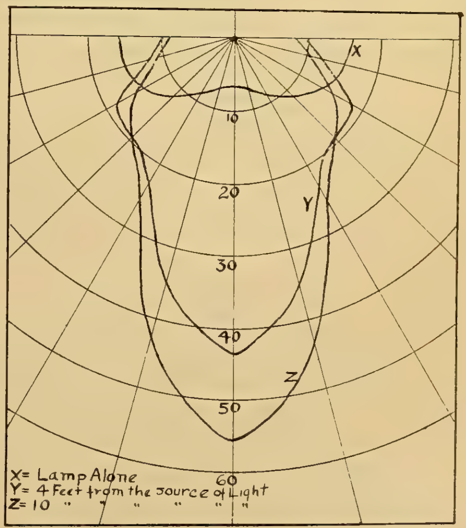


FIG. 3.

shown for the concentrating reflector this is not the case. However, certain tests with concentrating reflectors have shown a much higher efficiency of total amount of light than could possibly be the case with such reflectors, and this is probably due to the inverse square law not being strictly applicable.

With some photometers measurements are made by moving a photometer head between the lamp tested and the standard lamp, but in the cases where the reflectors are tested this method should not be used, especially where the photometer head is moved a considerable distance, as this produces a variable distance between the reflector and the photometer head. Instead, this should be a fixed distance and should be equal to the height above the fact is proved by a test on a concentrating plane of illumination at which the lamps and reflectors are ordinarily used in practice. It would be very much better if the distance at which the reflectors and reflecting devices are tested in the various photometric laboratories could be standardized, say, at ten feet, so that tests from these various laboratories would be more strictly comparable; but as it is now, one may be somewhat skeptical about comparing the results of certain tests, not knowing just how they were made. The standard distance should be a considerable one, so that the ratio of this distance to the diameter of the sources of light, including reflectors, will be great, and at the same time should be equal to the average distance from the plane of illumination that such light sources are to be used in practice.

It would be well if in the bulletins and advertising matter giving distribution curves of lamps and reflectors, the distance at which these were tested were given, and if it were pointed out that the values given were not true candle power values, as ordinarily understood, but apparent candle power values.

In a great many cases where lighting installations have been calculated by the point by point method, and when the results have turned out to be considerably different from those calculated, the differences have usually been ascribed to the wall and ceiling reflection, which is somewhat of an indeterminate quantity. However, it is more than likely that the effect of the difference in apparent candle power when light sources are tested at different distances must be a factor in the difference between results obtained and the calculated illumination. Thus, if the curve in Fig. 3 for the test at four feet were used to calculate the illumination on a plane ten feet below the reflector, the illumination would be found to be $\frac{43.3}{10^2}$, or .433 foot-candle, whereas the real illumination would be .56 foot-candle, 29 per cent. greater, which would have been the calculated value had the lamp and reflector been tested at the ten foot distance. This illustration emphasizes the fact that light sources with reflectors should be tested at a standard distance, in order that the resulting curves may be properly compared.

The Effect of Light of Different Colors on Visual Acuity

By J. S. Dow.

A considerable amount of research has been expended upon this subject by physiologists of the past. It is unfortunate that much of this work is only to be found in scientific transactions in Germany and elsewhere, with which the illuminating engineer is not in general acquainted, and that the literature is so very scattered.

It is, however, gratifying to observe that increasing efforts are now being made to study these questions from the practical standpoint of illumination. For instance, an account of some very interesting work on this subject has recently been published by MM. Laporte and Broca (*Bull. Soc. Int. des Electriciens,* June, 1908). Still more recently a paper has

appeared by Prof. S. W. Ashe in the *Electrical World* (February 25), describing some experiments which led to somewhat different results.

Prof. J. A. Fleming, in his well-known paper on photometry before the Institution of Electrical Engineers in 1902, drew attention to the desirability of distinguishing between two distinct qualities of illuminants, namely, the "power of creating brightness" and the "power of revealing detail." He also proposed the use of so-called "discrimination-photometers," based on acuteness of vision, in which two lights were compared by their relative ability to enable the eye to distinguish fine detail.

That some method of comparing this quality of revealing detail on the part of light of different colors is desirable may be admitted. But at the same time the author would suggest that such a test must be regarded as quite distinct from "photometry" as the term is usually understood, and has only a restricted application. For the use of light in order to enable the eye to perceive very fine detail, to read print, for example, though an important function of illumination, is only one among many purposes for which light is intended. And, apart from any question of the relative accuracy of the two systems, it seems probable, at the present moment, that our method of comparing the powers of "creating brightness" on the part of illuminants is the best test of their general value.

In attempting to study the question under consideration it is desirable to form a fairly exact idea as to what is meant by "visual acuity." The generally accepted sense in which this term is used seems to be "the ability of the eye to perceive fine detail," such as small print, etc. Occasionally, however, people seem to have used the expression to denote the power of appreciating fine distinctions of light and shade, which is a somewhat different matter, though, of course, also important and closely connected with visual acuity.

It may also be pointed out that there is some vagueness about statements to the effect that certain varieties of light are "good for reading." Is it meant, for instance, that the type appears exceptionally sharp and distinct to the eye when illuminated by this light? Or that we can read a book so illuminated for an unusually long period without fatigue? It seems quite possible that these two conditions may not be identical.

It is, indeed, very difficult for an engineer or physicist who does not secure the co-operation of some one closely in touch with the latest developments in

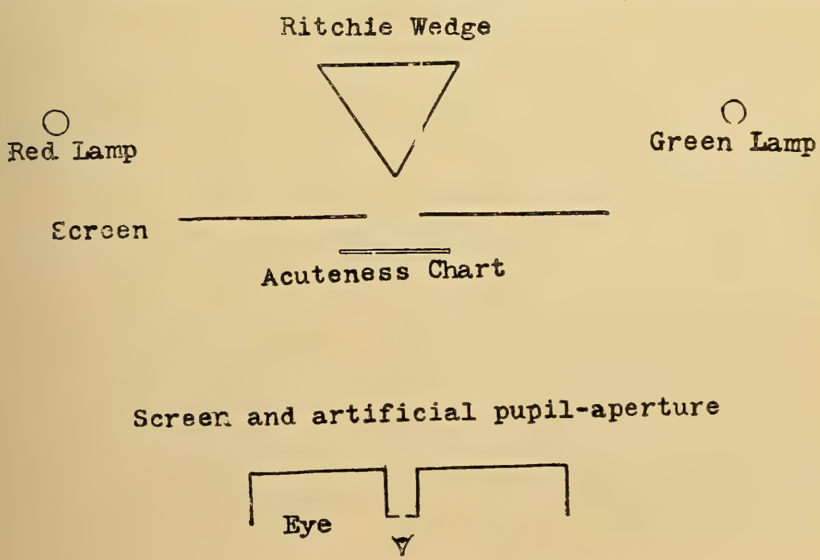


FIG. I.—GENERAL ARRANGEMENT OF APPARATUS.

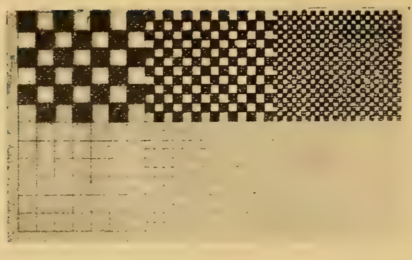


FIG. 2A.

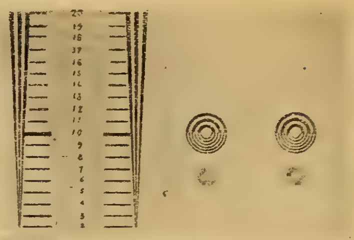


FIG. 2B.

physiological optics to avoid his results being vitiated by some physiological effect which is apt to obscure the real point at issue. This point may be stated as follows:

Suppose a white surface, on which is inscribed some fine black detail, such as small letters, is illuminated in turn by light from different portions of the spectrum, the light being adjusted in such a manner that the surface appears equally bright to the eye in each case. Under these conditions, will the detail be clearer and more easily perceived by the eye by light of one particular color. If so, which kind of light is best for the purpose?

In order to study this question it is essential to treat both kinds of light fairly by securing that the surface appears to have the same brightness in each case. It is, of course, no easy matter to compare accurately the brightness of two adjacent surfaces, illuminated by lights differing in color, but the experiences of many observers suggest that there is no insuperable difficulty in making an approximate judgment. On the other hand, it would seem desirable to make sure *by actual observation* that the brightness really does seem to be the same in each case, and not to calculate from some assumed law that it is so. Therefore in making experiments on this matter the writer has employed a wedge, the two sides of which could be illuminated by two heterochromatic sources, as shown in the diagram, Fig. 1. Transparent lantern slides, on which detail of various kinds had been photographed, were then placed in front of the wedge so that this detail could be viewed simultaneously by the aid of the illumination of both colors; some of these acuteness of vision charts are to be seen in Figs. 2a, 2b, 2c, 2d.

MM. Laporte and Broca, in their researches, used a similar arrangement. It has at least the merit of enabling us to feel sure that we are really comparing the detail-revealing powers of the two qualities of light studied, under approximately equal conditions as regards illumination. It may be added that in the arrangement used by the author provision was made for the distance of the eye from the detail being maintained constant and measured.

Professor Ashe appears to have calculated the illumination by which his

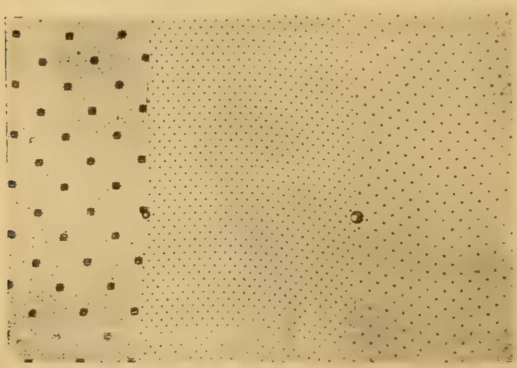


FIG. 2C.

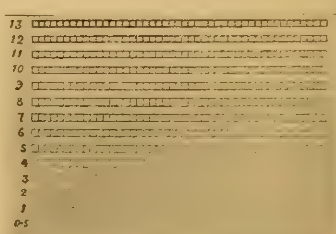


FIG. 2D—GRADUATED DETAIL.

tests were conducted by the inverse square law, and to have used a flicker-photometer. The writer, however, would venture to suggest that this method is not so satisfactory. In the first place it is legitimate to question whether, in a research of this kind, where lights of such different colors are used, readings of a flicker instrument constitute an entirely satisfactory method of judging "equality of brightness," on the maintenance of which the whole value of the experiment depends; in addition, according to his experience, theoretical calculations of illumination are apt to be very misleading in heterochromatic comparisons owing to the disturbing influence of the "yellow-spot" and Purkinje effects.

Many observers have attempted to compare the "visual acuity" in different portions of the spectrum by placing a small object in the eye-piece of a telescope in the spectrometer and gradually dimming the illumination until it became indistinguishable. Naturally such experiments have not infrequently suggested that greenish-blue light was the best, but probably merely because, at the very low order of illumination necessary to cause the object to appear indistinguishable, this is the region of the spectrum where the *luminosity* is greatest; therefore, they can hardly be taken as an illustration of the relative detail-revealing powers of different regions, *for the same intensity of illumination,* and at ordinary high illuminations. Instruments which depend upon the dimming of the existing illumination to very low values seem to the writer to be open to objection, on the ground that they utilize the illuminants compared under physiological conditions, which are apparently quite different from those prevailing at ordinary working illuminations. It may be suggested that, as a matter of principle, such measurements should be undertaken at the actual order of illumination which the illuminants will be required to supply.

Another possible source of uncertainty in making tests of visual acuity by lights of different colors is brought into play by adopting the plan of setting up some type of a given size and then walking backward until it just becomes indistinguishable. Here, again, the visual angles thus calculated may fail to afford a fair comparison of the acuteness of vision by different qualities of light, because, in walking away from the object, we bring into play a different region of the retina, and so alter, not only the visual angle, but also the *apparent brightness of the illumination.* The central region of the retina has been found by many observers to be less sensitive to the blue and green end of the spectrum than the surrounding region. Hence, although we may secure that the illumination is the same in the case of the two colors compared at close quarters, this may be no longer the case at a distance. For this reason also the writer prefers an arrangement in which the eye is maintained at the same constant distance from the two illuminated surfaces during the experiment, and the visual angle is altered by some method other than withdrawing the eye.

In order to be able to vary the visual angle subtended by the detail studied without altering the distance of the eye, the author has sometimes made use of graduated detail of the variety, such as the tapering striped pattern shown in Fig. 2b. In this case a measurement of visual acuity was secured by noting the exact point at which the eye was unable to detect the transition from the black stripe to the adjacent white one.

In using the apparatus described, however, the author first attempted to use a discrimination-photometer on the lines laid down by Dr. Fleming *(loc. cit.)*, using the pattern of fine dots, Fig. 2c, at such a distance from the eye that the dots just fell within the minimum visual angle of distinct vision (about 1 minute). In a photometer of this type one merely seeks to balance the illumination so that the sets of dots superimposed over both fields in the photometer became equally distinct. An artificial pupil-aperture of 2 mm. diameter was used, this being considered sufficient, at the order of illumination employed, to be well within the minimum value assumed by the author's eye.

The experiments were carried out with incandescent lamps screened with gelatines and solutions of various colors. Naturally the tints so obtained do not

quite correspond with pure spectral colors. There are, however, organic dyes which, in solution, or spread upon gelatine surfaces such as "fixed" photographic plates, enable a very pure red or green light to be obtained, though naturally at the expense of a considerable loss in light. The purity of these colors was studied by means of spectrometric examination; though not quite equivalent to pure spectrum tints, they should probably answer the purpose of exhibiting qualitatively the main phenomena examined.

(*To be Continued.*)

The Proposed International Unit of Light

In order to determine as accurately as possible the relations between the photometric units of America, France, Germany and Great Britain, comparisons have been made at different times during the past few years between the unit of light maintained at the Bureau of Standards, Washington; at the Laboratoire Central d'Electricité, Paris; at the Physikalisch-Technische Reichsanstalt, Berlin, and at the National Physical Laboratory, London.

The unit of light at the Bureau of Standards has been maintained through the medium of a series of incandescent electric lamps, the values of which were originally intended to be in agreement with the British unit, being made 100/88 times the Hefner unit.

The unit of light at the Laboratoire Central is the bougie décimale, which is the twentieth part of the standard defined by the International Conference on Units of 1884, and which is taken, in accordance with the experiments of Violle, as 0.104 of the Carcel lamp.

The unit of light at the Physikalisch-Technische Reichsanstalt is that given by the Hefner lamp burning at normal barometric pressure (76 cm.) in an atmosphere containing 8.8 liters of water vapor per cubic meter.

The unit of light at the National Physical Laboratory is that given by the 10-candle-power Harcourt pentane lamp burning at normal barometric pressure (76 cm.) in an atmosphere containing 8 liters of water vapor per cubic meter.

In addition to the comparisons of electric and flame standards carried out recently by the national laboratories in Europe, one comparison was made in 1906 and two in 1908 between the American and European units by means of carefully seasoned carbon-filament electric standards, and as a result of all the comparisons the following relationships are established between the above units:

The pentane unit has the same value within the errors of experiment as the bougie décimale. It is 1.6 per cent. less than the standard candle of the United States of America and 11 per cent. greater than the Hefner unit.

In order to come into agreement with Great Britain and France, the Bureau of Standards of America proposed to reduce its standard candle by 1.6 per cent., provided that France and Great Britain would unite with America in maintaining the common value constant and with the approval of other countries would call it the International candle. The National Physical Laboratory, London, and the Laboratoire Central d'Electricité, Paris, have agreed to adopt this proposal in respect to the photometric standardization which they undertake, and the date agreed upon for the adoption of the common unit and the change of unit in America was April 1, 1909.

The following simple relations will, therefore, hold after that date:

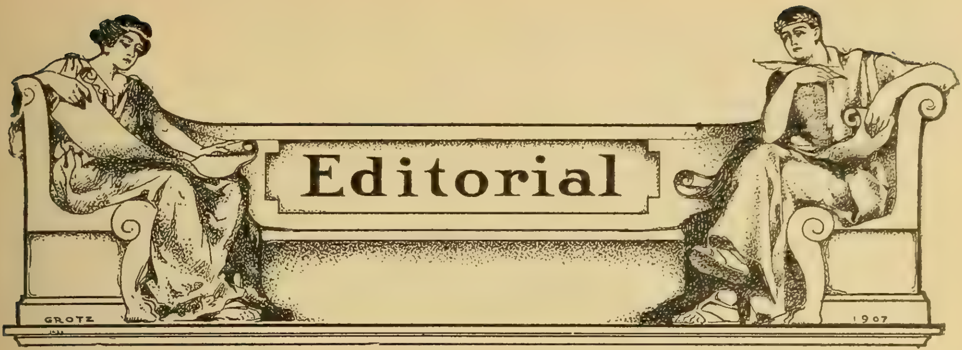
1 International Candle = 1 Pentane Candle.
1 International Candle = 1 Bougie Décimale.
1 International Candle = 1 American Candle.
1 International Candle = 1.11 Hefner Unit.
1 International Candle = 0.104 Carcel Unit.

Therefore 1 Hefner Unit = 0.90 International Candle.

The pentane and other photometric standards in use in America will hereafter be standardized by the Bureau of Standards in terms of the new unit. This, within the limits of experimental error, will bring the photometric units for both gas and electrical industries in America and Great Britain and for the electrical industry in France to a single value, and the Hefner unit will be in the simple ratio of 9/10 to the international candle.

The proposal to call the common unit of light to be maintained jointly by the national standardizing laboratories of America, France, and Great Britain the "International candle" has been submitted to the International Electrotechnical Commission, which will endeavor to secure the indorsement of the proposal by all countries of the world which are represented on that Commission.

It is hoped that such general approval may be secured, and that in the near future the term "International Candle" will receive general sanction.



The N. E. L. A. Convention

The N. E. L. A. convention might be called the "Commencement" of the electric lighting industry. It is customarily held when commencements and weddings abound, "'long about knee deep in June." There is the presentation of numerous essays and theses, various social festivities, a general round of compliments and then a parting until the next June. As every graduating class is always the superior of all its predecessors, at least in the opinion of the graduates, so every convention caps those that have gone before. As the normal rate of growth of the electrical industries is about 20 per cent. a year, it is perfectly clear that the association representing them should likewise increase; an increase is therefore no particular matter of congratulation unless it measurably exceeds the growth of the industry represented. Everybody expected that there would be a larger attendance at this convention than at any previous one and such proved to be the case.

The general value of the convention by way of the addition to the technology and literature of the subject represented in the papers, and the extension of acquaintance and good fellowship among the members is unquestioned, and is amply set forth in the general technical press reports. It is perhaps a presumptuous piece of bad taste to criticise or suggest that improvements are possible. We believe, however, that genuine growth and progress thrives better on honest criticism than upon fullsome flattery and that there were a number of points in the recent convention which could be materially improved upon. In the first place, the rooms in which the sessions were held were entirely unsuited to the purpose. The acoustic properties were about as bad as they could possibly be, with the result that it was practically impossible to follow the reading of any of the papers except by the very few in the front seats. Added to this was the distraction of rain on a tin roof and the barking of sea lions on the outside. The ancient practice, which has been repeatedly condemned by the unprejudiced, of having all the papers read by their authors and thus occupying the valuable time of the convention to the exclusion of discussion, was also followed. It is difficult to conceive of a more complete farce than a handful of men sitting patiently while some reader, whose voice and enunciation cannot carry twenty feet, laboriously grinds through a lengthy printed paper, a copy of which is in the hands of each of the audience.

As an example, after the reading of one important paper, the chair announced that ten minutes would be allowed for discussion. This sort of thing tends to arouse a suspicion that discussion may not be considered altogether desirable or safe. However that may be, there is no surer way to kill genuine interest in the convention and nullify the advantages which it should give than by a system of "cut-and-dried" proceedings. Had ten minutes been spent in presenting an abstract of the paper, or a short discussion by its author and the time consumed in reading it given to discussion, its value would have been at least doubled.

The entertainment programme was decidedly lame. Sailing trips were offered

daily to those who chose to hunt up the "inlet," wherever that particular spot may have been located, and to take their chances in a small boat on the open sea. The reception in the magnificent ballroom was decidedly attractive, but the vaudeville entertainment was performed by about as rascally a set of vaudevillians as ever broke loose upon an improvised stage and were only surpassed by the quality of the liquid refreshments served.

Taken all in all, there seemed to be a lack of the spirit and enthusiasm, both from the social and business standpoints, that has characterized previous conventions.

The facilities for exhibitors were unusually fine and this feature of the affair was decidedly successful. A considerable number of the exhibitors had the advantage of illumination from gas arc lamps, which to say the least added the spice of variety.

The thirty-second annual convention is now a matter of record and history. Let those who are responsible for the next gathering see what they can do in the way of improvement.

The International Unit of Light

A most important step in the progress of illuminating engineering has recently been taken in the agreement between France, England and the United States on a definite unit of light. The full announcement of the agreement arrived at, as issued through the Bureau of Standards, Washington, will be found on another page.

The difference between the international unit and the unit formerly used in this country is comparatively small and will make little commercial difference. The two cases in which the change will be most noted are in the rating of carbon electric lamps and in the photometry of illuminating gas. It would be well if government regulations regarding the latter could be amended at the first opportunity so as to specify the international unit; this will doubtless be done in many cases.

Now that the thing has been accomplished it is at least of passing interest to trace the history of the action and give "honor to whom honor is due," particularly as there seems to be a tendency to ignore entirely the source from which the movement originated, namely, the American Illuminating Engineering Society. The report of the sub-committee of the Committee on Nomenclature and Standards, presented by Dr. Hyde at the last convention of the society, gives an explicit history of the movement toward the establishment of a uniform standard of light up to that date, which leaves no possible doubt as to those responsible for the inauguration of the effort. Doubtless the same results would have been secured sooner or later had not the Illuminating Engineering Society moved in the matter; but that does not alter the fact that the society was the initial mover and is therefore entitled to whatever credit may be attached to such initiative.

The Progress of the Arc Lamp

Undoubtedly the most conspicuous feature of the N. E. L. A. Convention at Chicago last year was the tungsten lamp. While the lamp was not new, even commercially, it had never before made such an impressive showing to the general public. Furthermore, the part that this revolutionary improvement in electric lighting was to play in the future of the industry was still a matter of doubt and of no little apprehension. The lamp had come upon the horizon like a comet, but unlike that luminary it had evidently come to stay; and for better or for worse, its presence was a serious matter to be reckoned with.

Another year, however, during which the tungsten lamp has continued to increase in use at an unprecedented rate, has fully demonstrated the truth of what the majority gave as their opinion last year—namely, that its introduction would prove beneficial to both consumer and producer. All fears have been allayed, and the tungsten lamp is now an accepted and welcome factor in electric lighting.

At the recent Atlantic City convention the electric arc easily held the center of the stage. The flaming arc lamp, which made its official debut at the convention in the same city three years previous, and which was then handled somewhat as a monkey handles a hot chestnut, has also proven not only its usefulness, but also its perfect harmlessness to the lighting

industry. It is now agreed on all sides that the flaming arc has not only come to stay, but will occupy a large field of its own to the exclusion of the carbon arc. The most important single exhibition was the regenerative flame arc lamp, which was on view for the first time. This lamp is of English origin and at present of English manufacture, and was fully described in our previous issue. While its sponsors are ready to admit that there are still a few "bugs," there seems to be no reason to doubt that even in its present state it is a commercial possibility and that it represents the next forward step in arc lighting, at least so far as efficiency is concerned. This remarkable lamp gives a lower hemispherical efficiency, with an opalescent globe of a quarter of a watt per candle and a considerably higher efficiency with a clear glass globe. It also has the advantage of burning four or five times as long on one trim as the open flame arc and of giving a better distribution of light for many purposes. To the layman the only objectionable feature of the lamp is its uncouth appearance; but this perhaps is more due to its novelty than anything else.

The metallic, or luminous, arc is likewise making very substantial progress, as was pointed out by Mr. N. R. Birge in his paper.

The parallel progress of arc and incandescent electric lamps from the very beginning has been a curious phenomenon. It seems probable that the tungsten lamp, when finally perfected, will reach the limit of efficiency from incandescent solids; while the regenerative flame arc points clearly to the prophecy which we have previously made, that the final form of electric lamp will use gas or vapor as the luminous element.

Commercial Rating of Arc Lamps

It is not so long ago that the photometry of arc lamps was not sufficiently accurate to afford a means of any practical value for their rating on a candle-power basis. The development of the so-called integrating photometer by the late Professor Matthews, and the still more recent development of the spherical photometer in Germany, has now brought their photometry up to a point of accuracy comparable with that of other light-sources, so that the rating of arc lamps on a candle-power basis is entirely feasible at the present time.

The old question then arises, What shall be taken as the basis of measurement—intensity at a given direction, mean lower hemispherical, or mean hemispherical candle-power? A paper by Mr. C. E. Stephens read at the recent convention goes to show that the arc lamp manufacturers, or those responsible for their commercial rating, are taking a sensible and logical view of the matter. Mr. Stephens says:

"The old habit of comparing arc lamp on a mean lower hemispherical candle-power basis has been more or less discontinued and the present practice of basing the comparison on mean spherical candle-power and distribution curve substituted. The present method of comparison is a decided improvement over the old, in that arc lamps are generally used for illuminating large areas, and if the shape of the light distribution curve is known the calculation of the illumination that will be produced becomes a very simple problem. The various conditions, such as the diameter, position and quality of the carbon, which affect the shape of the light distribution curve are so numerous that it is only possible, in the present case, to note the typical shapes of these curves for the several types of arcs."

Now that the "powers that be" have come to a definite conclusion on a unit of light it is time to get to work on the establishment of a uniform method of rating light-sources; and in view of the successful termination of their first efforts, the Committee on Nomenclature and Standards and the Illuminating Engineering Society should at once take the matter in hand. There is but one method that can be applied to all light-sources alike and give always the information needed, and that is by the total light flux emitted, which should be given preferably in lumens; but for the time being, until the public becomes accustomed to the new term, it would be well to use spherical candle-power also. As Mr. Stephens points out, given the light flux and the distribution curve, the illuminating engineer should be able to produce any desired distribution for purposes of illumination.

Electrical Contractors as Illuminating Engineers

The occasion of the annual convention of the National Electrical Contractors' Association, which takes place this month, again focuses attention upon a matter to which we have previously called the attention of this important body—namely, the necessity of the electrical contractor taking up illuminating engineering and the exceedingly profitable field that is open to those who become competent and proficient in this line.

The commercial introduction of the new electric lamps, particularly the tungsten lamp, has to a large degree rendered every present electric lighting installation antiquated. To say nothing of the faults of the installations in themselves, therefore, it follows that almost without exception the electric installations at the present time could be remodeled to great advantage in point of efficiency and effectiveness of illuminating result. Furthermore, the majority of the present lighting installations are surely going to be remodeled, and this remodeling is going to be done on an illuminating engineering basis. The day of "stringing wires" for electric light is rapidly passing. People have learned a lot about illumination in the past three years, and they are not going to submit to bungling and guesswork to any great extent hereafter.

In a nutshell it comes to this: Both new and old installations are to be put upon an engineering basis. Is the electrical contractor going to be a mere day laborer, working to the specifications of a professional illuminating engineer, or is he going to make himself competent to furnish the engineering skill as well as the craftsmanship?

At least for all ordinary installations of electric light the electrical contractor is the natural one to look to for illuminating engineering skill. This holds especially true in all the smaller cities and towns. The electrical contractor should be able to handle the illuminating problems incident to his work just as the local architect must be able to handle the structural and all other engineering problems connected with a building. But the knowledge of illuminating engineering must be real and thorough, and not merely assumed; while complicated and difficult problems are not so frequently met with in the smaller city or town, they will nevertheless sometimes occur. A public library, or school house, or church, or other public building may be erected, and public spirit and local pride will see that as much of the work as possible is done at home. The requisite theoretical or "book knowledge" is no more difficult to obtain than the necessary knowledge of electrical science; and the contractor who excuses himself on account of lack of time or opportunity to study the subject of illuminating engineering is deserving of no better consideration than would be given the physician who declined to treat certain diseases on the ground that he had no time to study their pathology.

On a guess we should say that at least 75 per cent. of the work of an electrical contractor is in the installation of lighting systems. He is, therefore, by force of circumstances, in the position of a constructing illuminating engineer, and in a majority of cases can scarcely escape responsibility for illuminating results obtained. Let every electrical contractor so consider himself and proceed to make himself competent and to justify the title with all possible diligence.

An Omission

It is the wish and intention of THE ILLUMINATING ENGINEER to give full credit to all contributors and to every source of information. We published in the June issue a photograph of Times Square, New York City, showing a lamp standard erected by the Municipal Art Society. We were indebted to the courtesy of the New York Edison Company for the use of this photograph and intended to have so stated in the issue in which it appeared; but the acknowledgment was omitted through an error on the part of the engraver. We take this opportunity to correct the omission.

Notes and Comments

San Francisco Merchants' Association is Looking After Better Street Lighting

EMPLOYS AN ILLUMINATING ENGINEER TO GIVE EXPERT ADVICE.

It is an ill wind that blows no one any good; and even earthquakes and conflagrations have their advantages. If all American cities could be rebuilt at the present time there would certainly be great changes made. But only widespread conflagrations give opportunity for such improvement. In building the new San Francisco upon the ruins of the old advantage is being taken of this fact to make all possible improvements; and among these is a careful and systematic arrangement of its public lighting. The Merchants' Association is taking particular interest in this important public utility and has employed an illuminating engineer on its own account.

The work of the committee is thus stated by the *Bulletin:*

The committee of city lighting has made an investigation with a view to suggesting improvements. It was found that, even in the thickly populated districts, where lights are plentiful in number, there is a lack of uniformity. The committee engaged a competent lighting engineer and is formulating a scheme for a more uniform system, so that some sections may not be overlighted and some not lighted at all. The committee will make recommendations to the supervisors not only for the improvement of the present lighting system but for extensions of the system.

Night Baseball a Success

TRIAL GAME AT CINCINNATI PROVES THE PRACTICABILITY OF THE SCHEME.

We noted in our last issue that plans were under way in several cities to illuminate baseball grounds artificially so that games could be played and witnessed at night, and predicted the success of the scheme. It was a safe prophesy, as the following special in the New York *Sun* proves:

Baseball by electric light had a thorough trial at National League Park here to-night and it seems to be a success. The infield and outfield were brilliantly illuminated by a battery of five mammoth lights installed by the inventor of the system, George A. Cahill of Holyoke, Mass., and flooded the field, making it almost as light as day. The game was played between teams representing the Elks lodges of Cincinnati and Newport, Ky., and was fast in all departments. The players handled hard infield hits with apparently as much certainty and ease as if they had been playing in the glare of noonday. What little difficulty there was experienced in judging balls fell to the outfielders, and those players missed but two out of a possible fourteen hits to the outfield during the seven innings played.

President Garry Herrmann of the Cincinnati Reds said after witnessing the game:

"Night baseball has come to stay. It needs some little further development, but with proper lighting conditions—conditions better than this experiment provided—will see the night sports immensely popular."

Manager Clark Griffith of the Reds said:

"I don't believe that night baseball is destined to rival the daylight article, but I will say I am much surprised at the ease with which the game was played to-night. Under improved lighting it will grow more popular."

A crowd of more than 4500 persons saw the game.

Milwaukee Gets in Line for Better Street Lighting

MAYOR'S VETO OF 29 RESOLUTIONS FOR EXTENDING STREET LIGHTING STIRS UP GENERAL AGITATION.

It is a rather curious fact, which ought to have the careful attention of all those favoring municipal ownership of lighting facilities, that the movement for better street lighting seems invariably to originate among private citizens, and requires not only their initiative, but financial support in order to take practical form. This is not an unmixed evil, for anything that attracts general public attention to municipal affairs is certain to have a wholesome influence. The advantage of better street lighting has been the topic uppermost for some time past in Philadelphia, St. Louis, Boston, and a number of other smaller cities, the result in all cases being highly gratifying to those in favor of the improvement. Milwaukee now comes to the front with a demand for a general brightening up throughout and the in-

stallation of an equipment built on modern ideas of art and utility. The *Wisconsin* has a long article on the subject, from which the following are extracts:

For three years public enterprise associations have been considering suggestions and plans to recommend to the aldermen that will make the two prominent city streets more brilliant evenings. As yet no definite recommendation has been received, but the associations having the matter under consideration have promised to devote time to the question this summer, so that some improved arrangement may be made for the long evenings of the oncoming winter.

When the unsightly and dangerous signs projected half over the street on lower Grand avenue, the thoroughfare was reasonably well lighted. The intermittent flashlight boards, however, provided an uncertain illumination, a light that was annoying to residents in hotels and harmful to eyes. In a memorable crusade all projecting electric signs were removed, giving the street a far more pleasing appearance in the daytime, but leaving it as dark evenings as a village highway.

The Council Lighting Committee has held repeated meetings to discuss improved lighting facilities. It has been suggested that the combined power plants in the city hall and public library be employed for the better illumination of Wisconsin street and Grand avenue. As yet no definite agreement concerning this proposed arrangement has been reached by the aldermen. The city electrician has pronounced the project practical, declaring it could be put into operation at a very small cost.

Ornamental Lighting Spreads in Oakland, Cal.

MORE ELECTROLIERS TO BE INSTALLED.

Oakland was one of the first cities to recognize the advantage of ornamental street lighting and to put in decorative lamp posts. The system is now to be extended, according to the *Tribune:*

By unanimous vote the council has decided to illuminate Jefferson and Harrison parks with electroliers when the Seventh Street Improvement Club carries out its plan of lighting that thoroughfare with similar lamps. The illumination of the main business streets with electroliers is a great improvement on any system of street lighting previously adopted. The electrolier lamps are attractive street ornaments in the daytime, and the brilliant light which they shed at night adds immensely to the value for business purposes of the property fronting on the thoroughfares where they have been installed.

Buffalo, the "Electric City," Hears of Edison's Invention of the Electric Lamp

AFTER A RIP VAN WINKLE SLEEP OF TWENTY YEARS BEGINS TO INSTALL ELECTRIC LAMPS IN ITS CITY AND COUNTY BUILDINGS.

Just why Buffalo has called itself the "Electric City" has always been a puzzle to the innocent outsider. Probably those giving it the title were dreaming, and dreams always go by contraries. As previously noted, however, there are unmistakable signs of its awakening to a realization of what modern electric lighting really means. Whatever excuse it may have had for taking the title was evidently the proximity to the Niagara electric power stations. This, however, seems to cut no figure in the present movement, as the buildings are to be lighted by municipally owned isolated plants. This is an unimportant detail, however; the important point is that the buildings are not only to be illuminated in a modern fashion on the interior, but are to actually have outlined lighting on the exterior. Unless all previous signs fail this innovation will set the pace for the whole city, and decorative and spectacular lighting will follow in short course. The *Courier* thinks that "it may throw some light on City Hall affairs," and has this to say about the proposition:

Buffalo, long known as the "Electric City," is at last to have an electric lighted public building. The old City and County Hall is a very substantial structure, but the gas lighting of the interior offices has been a huge joke, if not a disgrace, to the community.

The new lights will be warmly welcomed by all the attachés of the building, and principally by the clerks in the County Clerk's office. The bookkeepers, title searchers and others who have occasion to use the office either daily or occasionally have more than once mentally castigated the lighting arrangements. On a dark day in some sections of this office, which takes up the central and northwest end of the building, it is impossible to read the books and documents unless the heavy volumes are moved into the light.

Visitors to the city will find the exterior of the building a beautiful sight at night. There will be rows of incandescent globes around the edge of the cornice work. There will be hundreds of lights placed on the tower and a permanent "Welcome" sign will also

probably be installed. Instead of being a dark and gloomy structure in the evening the old building will be a blaze of light which can be seen from Main street and Niagara street.

Government Printing Office Preparing to Jump Out of the Illuminating Frying Pan into the Fire

IS TRYING CLUSTER LIGHTING IN PLACE OF MERCURY VAPOR LAMPS NOW IN USE.

The lighting of a large printing and publishing establishment, of which the Government Printing Office is probably the largest in the world, is undoubtedly one of the most complicated and difficult problems which can ever be put up to a practical illuminating engineer; and it is not surprising that many experiments have been tried and much complaint and dissatisfaction heard. The one satisfactory aspect of the whole thing is the fact that those responsible for the lighting of the new plant have given the matter the most careful and painstaking attention and have made every effort to secure the best illumination possible. The original system was almost exclusively individual drop lights with metal reflectors. Later mercury vapor lamps were installed to a large extent. Now it seems that tungsten lamps in clusters are to be tried out. Whatever may have been the faults of the other two systems, it is hard to see how an improvement will be made by installing such intense sources as tungsten lamps in clusters so as to form large units. The *Post* says:

Employees of the Government Printing Office may expect a change in the lighting system of the workrooms if favorable results are obtained from experiments with the new tungsten lamps. A trial of 100 five-cluster lights is to be made, with the idea of displacing the "green" lights now in use.

Public Printer Donnelly is desirous of furnishing the best possible light in the big plant, both as a protection to the eyesight of the employees and as an increase in the quality and quantity of the output. The bright, shiny lead produced by the typesetting machines is said to be a handicap in the use of the ordinary illuminant.

Merry War Over Street Lighting in Springfield, Mass.

GAS AND ELECTRIC COMPANIES LINED UP FOR BATTLE.

The gas lighting interests are not all dead yet, as the following from the Springfield *News* will indicate:

At the expiration of the present contract with the United Electric Light Company for street lighting, which expires July 1, the Selectmen will consider the idea of lighting the streets with gas. The Selectmen expect that the Springfield Gas Light Company will compete with the electric company for the contract, which will probably be made for a term of at least three years.

The Springfield Gas Light Company has installed new gas lamps on Park avenue that have given satisfaction. The Selectmen are observing the service these lights are giving, so that when they get ready to award a contract they will know something of the service given by gas lamps.

The United Electric Light Company has had the contract for lighting the streets since the town adopted electric lights. The town owns its poles and wires and the company furnishes the current only. The company will spare no effort to obtain another contract, and, if the gas company offers stiff competition, it is thought the United company will make more suitable terms than it did three years ago.

St. Louis Planning to Open Its New Street Lighting Next Fall

WILL MAKE IT A FEATURE OF ITS CENTENNIAL CELEBRATION.

One of the most comprehensive plans for the betterment of public lighting to be taken in hand by civic organizations is that of the Merchants' Association of St. Louis, which has been previously mentioned in these columns. St. Louis has been in a muddle over its electric lighting for several years the local lighting company being under fire continually on the usual charges in such cases. Matters seem to be mending, however, and with the completion of the extensive and magnificent system now planned there will probably be a better feeling all around. The city is to have its own centennial celebration next October and is counting on the lighting as a most important attraction. The *Globe-Democrat* says:

The Illuminating Committee of the Centennial Association has on foot a plan for lighting the downtown public and business buildings of St. Louis during Centennial Week, October 3 to 9, which is expected to give a spectacular brightness to the streets during the night celebrations. Charles P. Senter, chairman of the Illuminating Com-

mittee, is soon to call a meeting of his committee and work out the plan more in detail. The Downtown Lighting Association will have its new system of street lights in readiness for Centennial Week.

It is planned to have the City Hall, Court House and other public buildings outlined with electric lights, after the manner the World's Fair buildings were. In addition, the business men along Washington avenue will be asked to display an electric sign or trademark in front of their houses. Special colored electric light displays also will be arranged at prominent downtown corners.

It also is designed to have electric banners on Olive street, marking the different old city limits, thus telling the story of the city's growth.

All Sorts

ITEMS CURIOUS AND INTERESTING FROM THE GENERAL FIELD.

Love's young dream is to be brutally awakened in Philadelphia by the glare of electric arcs. Girard College is surrounded by a high wall, originally intended to keep out preachers and priests of all descriptions. The shadow of this wall, it seems, has been utilized as a lovers' walk, to the disapproval of the citizens "over the way," who have petitioned the city councils to put up electric lights along the street as a preventive. In their petition they say that the walk "is used as a trysting place for lovers, some of them not out of their teens."

Mr. Alton G. Miller, for seven years general manager of the Consolidated Gas, Electric Light & Power Company of Baltimore, has been elected vice-president and general manager of the Union Electric Light & Power Company of St. Louis. Mr. Miller was phenomenally successful in the previous positions which he has held. It he can succeed in straightening out the situation in St. Louis and turning what appears to the outsider as general public disapproval of the local lighting company into public confidence he will deserve equally well of his company and the citizens. His succes is of more than local importance, since the situation in St. Louis has become pretty generally known. It is to be hoped that the citizens will give Mr. Miller every reasonable opportunity and assistance in establishing an *entente cordiale,* as Mr. Miller has a record for working on the basis of "the square deal."

The City Council of Seattle has voted $6900 for the construction of a handsome arch of welcome to visitors to the city and exposition. The structure will stand 65 feet high and will consist of two immense white columns, between which will be swung elaborate devices, which will be changed from time to time to conform to the various features of the exposition.

The festoon lighting on the boardwalk at Atlantic City is to be extended as far as the Inlet, thus increasing the attraction of this famous causeway.

The local lighting company of Toronto, Canada, advertises that it has employed an illuminating engineer, whose services are offered gratis to its patrons.

The County Commissioners have decided to outline the court house in Tacoma, Wash., and are asking for bids from local electricians for the installation.

Danvers, Mass., celebrated for its onions, is to light up its public square with flaming arcs, which are to burn all night.

Superintendent of Lamps and Lighting McCuen of Baltimore is in trouble with citizens who want to eat their cake and keep it too. While they are all anxious to have more street lamps, each wants the lamp post put up on another's property instead of his own. Mr. McCuen is working out a system for increasing the number of lamps in the city, taking a section at a time, and he has stated plainly that he will not permit private interests to interfere with public benefits.

The Lamp Lighters' Union of Boston have a poor opinion of electric street lighting. They have sent in a protest against the proposition of the Edison Company to replace the old-fashioned gas lamps with electric lamps.

From an English Correspondent

The problem of electric lamp maintenance has been one which has in past years been most vigorously discussed, the result being that at the present time a considerable number of supply authorities have adopted a system whereby they undertake to maintain and renew the lamps of such consumers as obtain them under certain conditions from the supply authority. The object of this arrangement is not only to promote good feeling and a sense of security on the part of the consumer, but also to insure that wastage of current for a total amount of illumination over the supply authority's system does not take place. Others again have rejected the system of lamp maintenance as being an unwise and expensive procedure, allowing their customers to exercise their own discretion as to the type of lamp which they purchase, and to take the risk as to the number of hours which such lamps will burn.

It must be remembered that the whole of this development, although modern, was practically discussed, and a decision arrived at as to the desirability of lamp maintenance, during the time that the carbon filament was, generally speaking, the only lamp worth considering. An exception must, of course, be made in the direction of the Nernst and tantalum filament. An important point arises out of this position. All these lamps are subject, to a greater or less extent, to what may be termed "electrical deterioration" of their filaments. Expressed simply, this means that the passage of electric current, by means of which light is generated, produces deterioration either in the form of blackening, crystallization or some other effect on the filament, which in course of time produces diminution of light, undue consumption of energy or excessive fragility of the filament. In these lamps the electrical conditions of use are the bases of their life.

Now in purchasing electric lamps of all types there are three classes of buyers to be considered, each of which has its own peculiar point of view. The first is the electricity supply authority, whose attitude in relation to the life of lamps is as stated above, and which has a staff of technical experts capable of conducting electrical tests on the lamps in order to insure that the best average conditions are obtained throughout the life of the lamp. The second class is that of the contractors and selling agents. Many of these are men of integrity, who would not willingly sell a lamp which they knew to be inferior in quality, but at the same time stress of competition has produced selling agents whose sole object is to get rid of as many lamps in a given time as possible without any regard for the ultimate value of light obtained over the life of the lamps. It may not be considered too strong a statement to say that a selling agent can arrive at a town, deposit a stock of lamps at a convenient storehouse, pay a visit to the principal shop keepers with sample lamps having a high initial brilliancy, clear out his stock and disappear from the town for a period of years. The third class of buyer is the general public, which knows no technical data and bases its comparisons of lamps upon the comparative observations of brilliancy as judged by eye, probably at a period near the beginning of the life of a lamp.

It is obvious that a maintenance arrangement is advantageous both to the consumer and to the supply authority in the case of lamps in which electrical con-

ditions are the basis of life, inasmuch as the supply authority can, by taking photometric tests, determine the class of lamp which it is prepared to buy under the conditions of its supply and to specify the same to the lamp makers. In this way it fulfils its contract to its consumer by giving the best average illumination for a given amount of energy extending for a term of some hundreds of hours of burning.

The problem has, however, been entirely altered with the introduction of the tungsten filament. The results both of laboratory tests and, what is still more important, practical working experience, has shown that the basis of life of these lamps is not electrical, but mechanical. For all practical purposes, excluding certain minor advantages gained by one maker over another owing to his having been in business longer and therefore having gained more experience in manufacture, all makes of tungsten lamps are practically equal electrically; the great difference of life which is found between various makes is due to their mechanical construction. The great trouble of tungsten lamps is their destruction under vibration. To meet this some lamp makers prefer to use few loops, each loop being long; others prefer short loops, a considerable number of loops being placed in each lamp. Some support the loops by the ends only; others have intermediate struts midway along the loop. There are also variations in the methods of connection and support. All of these features are mechanical. The whole question of maintenance, therefore, comes down to a proposition as regards vibration to which the lamps are subjected, and this may be supported by a case which has come under the writer's observation of a tungsten lamp which burned in a position free from vibration for 6000 hours, and at the end of that period its life was ended by means of mechanical shock.

It is evident that the conditions of supervision of lamps by a supply authority can only be of a very superficial nature if these depend on vibration, which is purely a local matter. One man may have his house on the top of a hill quite away from heavy traffic and his tungsten lamps will burn almost indefinitely. Another may be a shopkeeper and the vibration of carts and vans will be transmitted from the street to the shop. The third may be a private householder in premises adjacent to a railway line. If a system of lamp maintenance were to be adopted by a supply authority feeding all these consumers it would be, in the absence of adequate control of vibration, both useless and expensive.

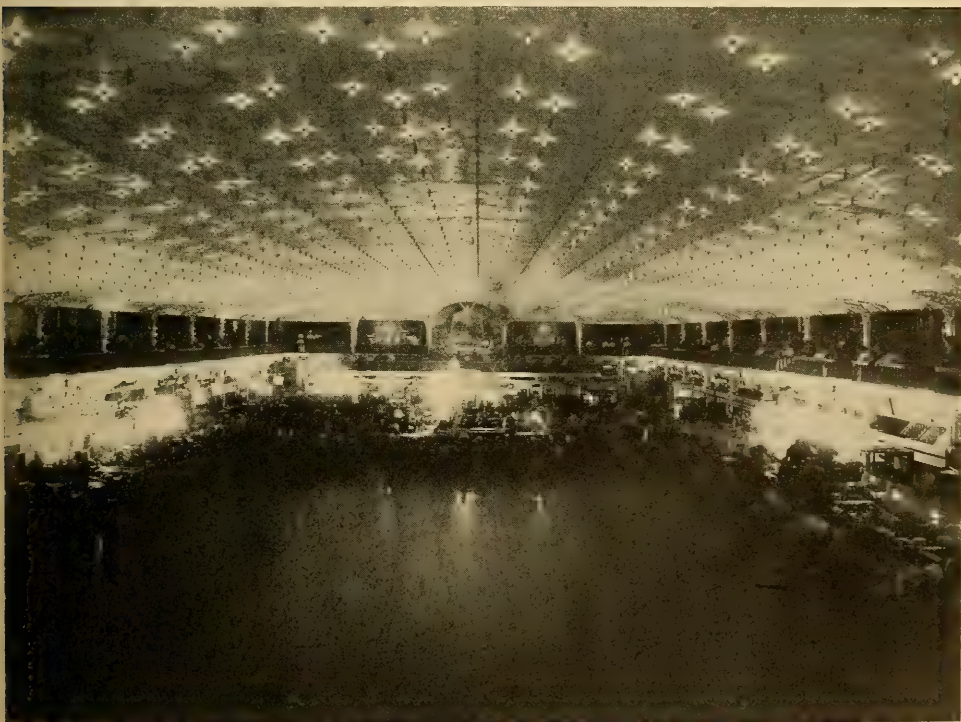
The position, therefore, appears to be this: that so long as the bulk of the lighting on a supply authority's system is conducted by means of carbon filament lamps and other types which are subject to electrical deterioration, a system of lamp maintenance is useful and beneficial, but, as is very widely the case, as tungsten filament lamps are in operation, it becomes a matter of extreme doubt as to whether the maintenance system will not prove disastrous. As metallic filament lamps are now being so extensively used this development constitutes a very serious problem

CASHIER BOOKKEEPER CONTRACTS ADVERTISING

Commercial Engineering of Illumination

The Pavilion, Young's Million Dollar Pier, Atlantic City, in Which N. E. L. A. Exhibition Was Held

The splendid pavilion, a night view of which is shown in the above illustration, furnished ideal facilities for the exhibition feature of the convention. The exhibits were arranged around the sides and at the rear. The spaces allotted were large enough to furnish comfortable quarters for the attendants and visitors, as well as to afford fine opportunities for the display of wares. The immense floor space was used as a sitting room during the forenoon and for dancing afternoon and evening, the general public being admitted, except on the first night, when the convention reception was held. The lighting is by lamps studded in the ceiling, as shown, alternate rows of blue and white being used. The orchestra occupies



EXHIBITION HALL, YOUNG'S MILLION-DOLLAR PIER.

the gallery at the rear. The only exhibitors who had an excuse for fault-finding were the arc lamp people, who were obliged to place their lamps a few feet from the floor in order not to spoil the effect of the general illumination.

Practical Illuminating Engineering in Connection with a Commercial Department

By G. A. Sawin.

Abstract of paper read before N. E. L. A. Convention.

The progressive commercial man is spending money for solicitors, newspaper advertising, signs and the like, to show his product. He virtually says to the customer, "Use electricity; we don't care how, only use it and pay your bills." The salesman of practically any other article is full of suggestions as to how and where to use his product to get the best results; in fact, a salesman without this information would sell few goods. Would not the salesman of electricity be assisted in selling his article by telling how and where to use it? The feature lacking in the method of both the operating and the commercial man is illuminating engineering. Of course, there are exceptions to this statement; of recent years especially, illuminating engineering has received considerable attention, but this only proves the rule that the great majority do not use illuminating engineering as it should be used.

A progressive company will seek to obtain the maximum value from all features in connection with its business; the maximum value from its apparatus, the maximum kilowatts per pound of coal, the maximum business at the least expense for solicitors. It should, to be consistent, obtain the maximum value from the newest feature, illuminating engineering. Many places where the illuminating engineer can be of assistance readily suggest themselves. A few are as follows: He can consult with customers complaining about their light and supply the remedy; he can often save consumers who think their electricity is too costly; he can prove to non-users that the cost of electricity is within their means; he can consult with new customers on locating lights, thus preventing future dissatisfaction; he can assist in obtaining new business by showing where electricity can be used advantageously, perhaps in place of other illuminants. It is not uncommon to hear the statement, "I do not use electricity—it hurts my eyes." The trouble here is not with the light itself, but with the location of the light. Now that the tungsten lamp is being used extensively, its higher intrinsic brilliancy makes the question of location of lights still more important. It is not inconceivable that a customer may on the score of injured eyes cease using electricity; in this case the illuminating engineer would be of assistance in so placing the lamps that a customer's eyes were not affected. Is not this feature of light injuring the eyes actually hindering the increase of business, and could not the people be converted by having the light properly placed? Here is another field for the illuminating engineer, where a company could use him to advantage. In short, the illuminating engineer supplies the one missing link between the central station and the consumer, rounding all into a perfect whole.

To get the best value from illuminating engineering a company should have in its organization, either directly under the commercial department or working in conjunction with it, one man who has made a special study of this subject. This man could be used in two ways: first, as a special agent at the call of any commercial man or solicitor; he would either be alone or have assistants, according to the size of the company; second, more in the nature of a consulting engineer who would personally visit special or important installations, but whose added duty it would be to train as many solicitors as practicable, depending upon the size of the company, in the fundamentals of illuminating engineering. The training should be such that the solicitor can talk intelligently with the consumer on this subject. These trained solicitors may be looked upon as inspectors for the illuminating department. They will be able to determine what the customer wishes, and can make necessary plans of the building to be lighted, to be forwarded to the illuminating department. This man may in simple cases determine the illumination himself, the head of the department granting this power at his discretion. In the latter case, the solicitor should always make a complete report to the illuminating engineer.

The second method has several advantages over the first, as follows: first, with a knowledge of illumination the solicitor would be able to talk approximate costs to obtain any desired results, and hence would be assisted in obtaining business; second, he could immediately give approximate answers about illumination, which is always pleasing to the customer; third, as the advice on illumination would be free, the company would undoubtedly receive many requests out of curiosity—if these are first investigated by the solicitor he can determine with the least waste of time if the man is in earnest;

fourth, the solicitor can care for simple cases with much saving of time; fifth, after advice has been given, the case should be followed up, as the customer may not be entirely clear in regard to the recommendations; perhaps the first cost appears too high and slight modifications or compromises may please him better; in short, the follow-up system should be inaugurated to insure a satisfied customer, and in this the solicitor would be invaluable, as the illuminating engineer would not have sufficient time to do this thoroughly.

The illuminating engineer would supply the formulæ necessary, checking all these before putting them into extensive use. He should supply prints showing places actually lighted, as samples to be used by the solicitor; in fact, he should be responsible for all lighting data used by the company and should see that the solicitors are properly informed and properly use the information given them.

The company should advertise the illuminating department extensively through newspapers, electric signs, pamphlets, on the backs of bills and the like. In its advertising, the company should state that the department is at the service of all, without charge; and that it furnishes free advice, not free wiring, free fixtures and the like. This would prevent a serious misunderstanding at the start. The advertisements will bring people to the company who wish improvement in illumination or the same illumination at lower cost. It will bring many of these people while they are in the first stages of dissatisfaction, instead of having them wait until they are sufficiently disgruntled to tell all their friends and finally complain bitterly to the company.

Besides the cases which come to the notice of the department through advertising, the complaint or information department should notify the illuminating department where customers complain of high bills, poor lighting and the like. The knowledge that the company maintains such a department would be of great assistance to the agent in settling complaints. Care should be exercised to bring to the attention of every new customer the fact that the company maintains an illuminating department and is willing to advise him before he is connected to the lines. The new customer, perhaps, is using electricity as a trial. If the lights are poorly arranged, not enough or too many, the customer may cease using electricity, hence a new-business department could use illuminating engineering as a means to insure the holding a new customer. New buildings being erected will, of course, be known to the commercial department, and they should make it a point to confer with the owner and architect to see if the illuminating department cannot be of service to him. The owner may have decided not to use electricity, but with the aid of the illuminating department he may become a customer.

A solicitor with the knowledge that the illuminating department is behind him would not be afraid to approach any customer and suggest improvements in his illumination, and, by so doing, the customer would realize that the solicitor was watching the customer's interests, and this would promote good feeling. In short, all branches of the commercial department should have the illuminating department in mind at all times, and the organization should be such that notice of advice wanted on illumination automatically reaches the department from all angles.

To sum up, each company should have in its organization an illuminating department, consisting of an illuminating engineer at the head, with sufficient assistant engineers and inspectors to care for the business properly. The assistant engineers will be in the office with the illuminating engineer, but, of course, could be omitted if the volume of business did not warrant their employment. The inspectors would, except in special cases, be the first to visit the consumer who desired advice, and his duty would be to learn the customer's wishes and to make a sketch of the premises, to be sent to the illuminating department. When this report is received, the illuminating engineer or his assistants will calculate the proper illumination and return to the solicitor, who will hand the information to the customer. The inspectors may be in the office of the illuminating engineer; but better, as expressed in the first part of the paper, they would be trained solicitors who combine illumination with their other work. The number of inspectors or inspector-solicitors would depend on the size of the company, but there should be enough to promptly investigate and follow up consumers desiring advice. In the larger companies there should be enough in each sub-district to care for that particular district.

The illuminating department should be a separate branch of the commercial or sales department, the engineer reporting to the chief commercial or sales agent. All other branches of the commercial department, such as contract, complaint, new business, new buildings, publicity and so on, should immediately notify the illuminating department when advice is desired.

The report to the customer should be complete in all details, and should include a drawing that the customer could hand to his wireman if he so desired and tell him to go ahead. Height of lamps, style of reflectors

and all essential details should be carefully specified.

The illuminating engineer should be equipped with all available magazines and technical papers, catalogues of fixtures, shades and the like, and should keep strictly up to date on all points. He should have one or more portable photometers, and should compare calculated results with measured results with great detail.

At the end of each month every inspector should report the result of his follow-up system, stating whether the customers were satisfied or not and objections raised. The department should make every possible effort to satisfy the customer, this being the principal object of the illuminating department. In all work undertaken by the illuminating department the customer's interests only should be considered; in other words, the companies should strive to give him the best light for the least money. This is not only the best policy in the long run, but it is most important at the start in order to dispel any skepticism of the company's good intentions.

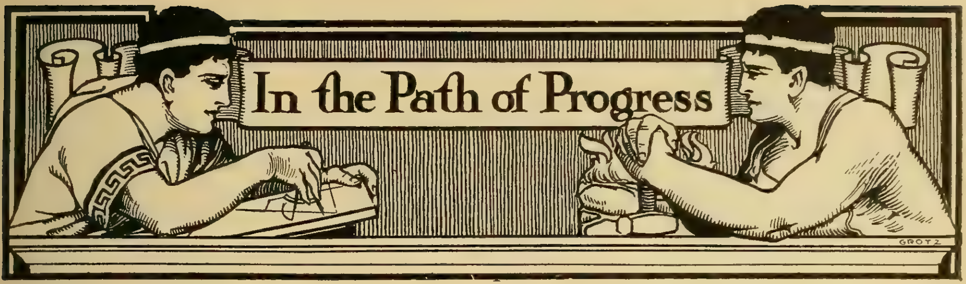
In conclusion, we would say that the object of the illuminating department is, briefly, to assist the company to sell its product, to hold its present consumers, to eliminate complaints and to establish friendly relations with consumers. The department, if properly operated, will do excellent work in these directions. The company should bear in mind that if it does not establish such a department or if it does not operate such a department in the interest of the consumers, before long some independent illuminating engineer will find that district a good field for work. This will doubly react against the company, since new customers obtained by independent means would either be neutral or dissatisfied in paying for a service which other companies furnished free, and the company would get no credit for help given present consumers.

As an illustration of what an illuminating department would do for a company, let us take the following analogy: We know from chemistry that we may have a poor or useless substance, but by mixing another with it cause the former components to separate, unite in some other manner, and although all the former parts are still present the new combination may make the whole a useful substance. Thus if a company has its consumers complaining and no profits, and we add good illumination, we may get, using the chemical notation, the following: Consumer's complaints + no profits + good illumination = no complaints + good profits + illumination consumers. The company gets what it wishes in good profits and no complaints, and the consumer becomes what he should be, a consumer of illumination and not merely of electricity.

The Twenty-fifth Anniversary of the Berlin Electric Works

The recent celebration of the Berlin Electric Works of the Twenty-fifth anniversary of its founding has aroused no little public interest in the history of this pioneer of German central stations. This is a branch of the Allegemeine Electricitaets Gesellschaft (General Electric Company), whose founder and director, Herr Rathenau, celebrated his seventieth birthday last Christmas. Herr Rathenau became interested in electric lighting on his visit to the Electrical Exposition in Paris in 1881, where he first saw the Edison lamp. Being at once convinced of its possibilities, he secured the German rights and set about investing capital in its promotion. To this end a model installation and studiengesellschaft (study company) was founded. After a few successful installations had been put in a banquet was held in Herr Rathenau's honor. But during the dinner he had observed that the lamps were growing dim, a fact which was not generally noticed by the guests, nor did they at once discover the disappearance of the guest of honor. Herr Rathenau went down to the power station in his evening dress and personally supervised the operation during the entire evening, thus assuring a successful performance. A failure at this critical time would have been disastrous.

A few days later, in May, 1883, a company was launched called the German Edison Company, which was later changed to the present title, known the world over in its abbreviated form, A. E. G. Exactly a year after its formation the new concern succeeded, after many difficulties, in obtaining a contract with the city of Berlin by which it was permitted to generate and furnish electric energy from one or more stations to a limited district. This corporation was called the Municipal Electric Works, and was the beginning of what is now the Berlin Electric Works.



Transformers for Electric Signs

We are in receipt of the following communication from the Central Electric Company, Chicago. It deals with an important subject in a thoroughly business-like and comprehensive manner and contains data of unusual importance to every one interested in electric signs. If the transformers put out by this company are as practical and suited to the purpose as this communication—and it is fair to infer the affirmative—they may be purchased with absolute confidence in their success.

Sign and Decorative Lighting with Tungsten Lamps.

It is generally recognized that the best results in sign lighting are secured by the use of small candle-power lamps, as in this way the letters and design in general can be more clearly outlined. As a rule 4 candle-power lamps are used, and in some cases 2 candle-power lamps have been employed to a considerable extent. The manufacture of low candle-power tungsten lamps for use on the ordinary lighting pressure is, however, commercially impracticable at the present state of the art on account of the extreme fineness of the filament that would be required.

Recently low voltage tungsten lamps of various sizes, from the miniature up, have been perfected, and on account of their comparatively thick and short filaments these lamps stand harder usage and have a longer life than the higher voltage tungsten lamps. By using a special transformer stepping down from 110 to approximately 10 volts the use of these low voltage tungsten lamps is made possible.

The ordinary 4 candle-power carbon sign lamp absorbs a total of 19.28 watts per lamp, as compared with a total consumption of 5 watts in the case of the 4 candle-power tungsten lamps. The saving is a ratio of substantially 4 to 1, and therefore graphically evidences the commercial possibilities and desirability of this new combination.

The following example, worked out in elementary arithmetic on the basis of 5 hours burning per day and 100 lamps for the sign, shows the marked saving resulting from the substitution of the tungsten for the carbon lamp for sign, decorative and outline installations.

Using Carbon Lamps.

100 lamps $\times$ 19.28 watts $\times$ 5 hours = 9.64 K.W.H. per day.

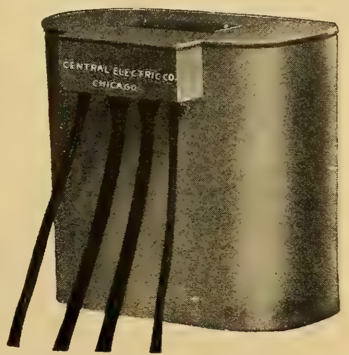
365 days $\times$ 9.64 K.W.H. = 2618.6 K.W.H. per year.

2618.6 K.W.H. at 5 cents = \$130.93 cost per year.

Using Tungsten Lamps.

100 lamps $\times$ 5 watts $\times$ 5 hours = 2.5 K.W.H. per day.

365 days $\times$ 2.5 K.W.H. = 912.5 K.W.H. per year.



CENTRAL ELECTRIC COMPANY'S SIGN TRANSFORMER.

912.5 K.W.H. at 5 cents = $45.62 cost per year.

From the above it will be noted that the difference in operating costs is $85.31, in favor of the tungsten lamps. It should be borne in mind, however, that from this apparent saving should be deducted the transformer initial cost and its cost of operation, which amounts to $13.75 total, thus giving an actual saving of $71.56 per year. The increased cost of the tungsten sign lamp is largely counterbalanced by the increased life which will frequently reach 2000 hours.

In considering the cost of transformer operation it should be remembered that the core loss, which in this case is 21 watts, and the copper loss of 11 watts should be figured for 5 hours, in that the transformer operates at approximately full load. It should also be remembered that in ordinary sign lighting the proportion in transformer core losses is quite high, in that signs like other current consuming devices are operated from the regular lighting or power mains, energized 24 hours a day, and, therefore, entailing a constant core loss in the various transformers supplying the lamps, a proper percentage of which loss is chargeable against the signs. On the other hand, the tungsten transformer is connected between the control switch and the lamps, so that the core losses only go on while the lamps are burning.

The use of the combination outlined above is advantageous both to the customer and the central station manager, as it enables the first to use a greater sign capacity for the same money and enables the second to secure more customers.

A decided advantage in using the tungsten lamp transformer for low-voltage lamps instead of placing a group of ten or so in series across the 110-volt circuit is that it permits any number of lamps to be used and avoids the complete extinguishing of a row of lamps when any lamp burns out.

The tungsten sign lamp is an exceptionally economical medium for the illumination of drug stores, libraries, dens and reception halls, as well as sign and outline work.

An Automatic Electric Economizer for Projecting Lanterns

Mr. J. H. Hallberg, whose name and fame as an electrical engineer are familiar to the entire profession, has designed a line of economizers which are especially adapted to the use of moving picture and other projecting lanterns. These are automatic in their regulation, and have been designed for both alternating and direct current. As these eliminate the

HALLBERG TRANSFORMER.

rheostat principle, it is needless to say that they affect economy in current, besides affording the necessary automatic regulation for the lamp.

Mr. Hallberg can be found at 30 Greenwich Avenue, New York.

Announcements

The Federal Sign System (Electric) has recently opened up another branch office at 1230-1231 Syndicate Trust Building, St. Louis, Mo. This makes eight offices in all which this company now maintains, one in each of the following cities: New York, Cincinnati, Kansas City, Philadelphia, Louisville, New Orleans, St. Louis and Chicago. In each of these cities the Federal Sign System (Electric) has developed a considerable sign renting business as well as a large sales business of electrical fixtures of all kinds.

Proceedings of Technical Societies

The National Electric Light Association

THIRTY-SECOND CONVENTION.

DEVELOPMENTS IN STREET AND PARK LIGHTING; *by J. W. Cowles.*

Mr. Cowles divides the subject of street lighting into the following classes:

(A) Urban streets.
(B) Suburban streets.
(C) Parks and boulevards.
(D) Display lighting.

In treating each of these classes, the following points are considered:

(1) Types of lamps.
(2) Wattage of lamps.
(3) Kilowatts per mile.
(4) Methods of installation, including type of fixtures, height of lamps above street, and the like.

Mr. Cowles finds a range of from 3½ to 20 kilowatts per mile, 10 kilowatts representing the most common practice. Samples of this class are taken from New York, Brooklyn, and Boston. For business streets of special importance the kilowatts per mile is often increased, and even double with excellent results by the use of two lamps per post.

For streets of extra width, or where the curb lines are broken by trees, the placing of lamps in the center of streets has distinct advantages from the standpoint of actual illumination. The advantages may be offset to some extent by the sidewalks being insufficiently lighted, if the street is of unusual width, or if there is an absence of the usual store window lighting. This objection may be overcome by the use of curb lamps at the corners, set diagonally. Recent installations in Boston, New York, Rochester, Philadelphia, and Baltimore are explained.

For public squares or wide areas foreign practice has been introduced to some extent by placing lamps of high candlepower at an unusual height above the street. An example of this kind of lighting is given as used in Boston, where flaming arc lamps have been placed 43 and 52 feet high. Although not yet adopted extensively, the results have been very pleasing.

In suburban lighting the commercial introduction of the series tungsten lamp seems to have the right of way, with such reinforcement of arcs as may be required at prominent points. Very few carbon filament lamps were found in use. The popular size seems to be 40 candle-power in preference to higher units, although 60 candle-power is reported in a considerable number and 80 candle-power in occasional cases. The stimulus thus given to incandescent lighting has called forth the attention that has been so long needed to the question of suitable fixtures, particularly for overhead wiring. A number of modern fixtures are shown.

For park and boulevard lighting, methods which contain both the urban and suburban practice seem to offer the best results. As underground construction is invariably standard in such cases, arc lighting varies but little from city standards. Tungsten lighting has proven itself well adapted to park use, and rapid progress has been made during the past year in the development of ornamental poles for such purposes.

Display lighting is illustrated by different examples, in which tungsten lamps are used in festoons over the street, and where magnetite or flaming arcs are used along the curb.

Mr. Cowles concludes that the question

of public lighting is now awakening the interest that it deserves. Very satisfactory progress is being made and the prospects for the future are excellent, if the good work already done is continued along sound and rational lines. A note of warning is sounded against overdoing the use of light, especially against placing large and brilliant light-sources too low down where they will come within the direct line of vision.

A word of warning may well be sounded against the adoption of the "More Light" slogan, without proper regard to the laws of both illumination and common sense. A tremendous blaze of light directly within the lines of vision of both the walking and riding public is not necessarily progression in its truest sense, and may result in retardation rather than advancement of the art. More science should be applied to the spacing or locating of street lamps in order that more uniform illumination may be obtained. How often do we see results mutilated most brutally by the location of lamps with regard wholly to political or selfish interests.

With the widely varying conditions and requirements of different cities, it is manifestly impossible to conclude that there is any "best system" of street lighting applicable to all cases, but it is hoped that the foregoing descriptions and illustrations of what has already been accomplished in different localities may suffice to encourage action on the part of those not yet awakened and to emphasize those points that must receive most careful consideration if permanently satisfactory results are to be expected.

Recent Types of Art Lamps and Their Operation; *by C. E. Stephens.*

Mr. Stephens' paper is devoted almost exclusively to a description of the Westinghouse Metallic Flame lamp, which we have previously described. He sums up the advantages of the Metallic Flame lamp as follows: High efficiency, low maintenance cost, almost ideal light distribution for street illumination, white color, and the fact that it can be operated with small current values.

The Present Status of the Arc Lamp for Street and Interior Illumination; *by N. R. Birge.*

Mr. Birge's paper is devoted to a description of the General Electric Luminous or metallic arc lamp and also the new form of enclosed carbon arc lately put out by this company under the name of the Intensified Arc. The former has been previously described. The latter is an ingenious form of carbon arc, using two quarter-inch positive carbons and a single three-quarter inch lower negative carbon. When operating at 5 amp. on 110 volts, the lamp has an efficiency of approximately one watt per mean hemispherical candle. The lamp burns 60 hours with one trim. The case and globe of the lamp are of more artistic design than the familiar enclosed arc.

Methods of Introducing Tungsten Lamps and Their Effect on Central Station Income; *by William H. Atkins, Editor.*

The subject is treated under the following heads:

(A) Different policies adopted.

(B) Methods of introduction and renewal.

(C) Use of large units in competition with gas arcs.

(D) Their effect on income.

The paper contains much valuable information gathered from companies having an aggregate connected lamp load of about 10,000,000 carbon lamps, and about 500,000 tungsten lamps. The information is in the form of answers to twenty-eight different questions. To the question "Is the demand for tungsten steadily increasing" the majority of answers are in the affirmative. Specimens of newspaper and pamphlet advertising are given, and the opinions in full of a number of central station managers.

Electricity for National Advertising; *by George Williams.*

After briefly stating the various and numerous advantages of the electric sign, Mr. Williams suggests that the Association collect information from each class A member on the following topics, and compile same for the benefit of members, advertisers, advertising agencies and sign builders:

(A) List of available roof locations; their descriptions and terms of rental;

(B) Flat rate of service for 4 candlepower and upward for a year of six and

twelve hour nightly burning, inclusive of lamp renewal and sign painting cost;

(C) Names and brands of articles already advertised by electrical display, accompanied by photographs.

This information should be collected and printed without delay in book form and tendered for sale to the members.

Users of electrical advertising display have these advantages:

1. The women everywhere admire the displays because the electric signs help brighten the city. This alone goes a long way in giving prestige to the brand or name of the advertised product.

2. The electrical interests in any city include the personnel of the central station, telephone, traction and electrical supply companies, sometimes directors and stockholders in these companies who also take an interest in electrical progress. The real estate interests are also keen to see the signs go up. All these people can be counted on to stand sponsor for electrically advertised products.

3. Electrical advertising is the one kind that can not be overdone. Darkness was made only to sleep in. The Police Department voluntarily protects the electric sign, and everybody has a kindly interest in it.

4. Electrical display is the only kind of advertising that people will pause to read repeatedly. The only kind that people will read with delight a thousand or more times in a year.

5. The readers do not have to buy it in order to read it.

6. The readers do not forget what they see or forget to talk about it with their friends.

7. Electrical advertising enhances the reputation of the product advertised—puts on the gilt edge, carries the difference in atmosphere between an engraved card and a printed one, lends the piano finish, suggests that superiority that you can realize right now by recalling the brands or names of the mineral waters, teas, biscuits, beer, razors, plows, dress trimmings, sewing machines, typewriting machines, garters, suspenders, confectionery, corsets or automobiles that are now advertised by electricity. You may not be in a position to know that these particular brands are the best to buy, but you think they are.

The Regenerative Flame Lamp; *by A. J. Mitchell.*

A description of the regenerative flame arc lamp made in England and marketed in this country by Adams Bagnall Electric Company. The lamp was fully described in a previous issue.

The Manufacture of Incandescent Lamps; *by J. E. Randall, Glen C. Webster, and S. E. Doane.*

A brief description of incandescent lamp making as carried on at the present time. Contains no new matter.

The Effect of Various Maintenance Conditions on the Efficiency of Illumination; *by A. L. Eustice.*

Mr. Eustice's paper, though comparatively short, represents the results of a long series of investigations to determine the deterioration under ordinary maintenance conditions of the various commercial light units. His observations covered a widespread range of conditions, including installations in Pittsburgh, Chicago, Minnesota, Milwaukee, St. Joseph, St. Louis, Duluth, Buffalo and Youngstown. The percentage of loss in illumination due to the collection of dirt and dust on lighting glassware ranged from 39 per cent. in a tungsten installation in Pittsburgh down to 8½ per cent. in a similar installation in Duluth. The average is about 20 per cent. With the Nernst lamp the highest loss was 10½ per cent. in a Chicago installation down to 1½ per cent in an installation in the same city, the average being about 6 per cent. The results of the investigation are the most comprehensive that have yet been published on this particular subject.

Practical Illuminating Engineering in Connection with the Commercial Department; *by G. A. Sawin.*

This paper will be found abstracted in the Commercial Department of this issue.

Reports of Committees. Committee on Progress; *T. Commerford Martin, Chairman.*

In the field of illuminating engineering Mr. Martin deals with Special Street Lighting, Metallic Filament Lamps, Flaming Arc Lamps and Other Lamps and Illuminants. A number of typical installations are cited and described, all of which have been previously noted in our columns.

As to metallic filament lamps, Mr. Martin says:

"Overwhelming is a word that might fitly be applied to the effect on central station art by the introduction of the tungsten lamp and its rapid cheapening. The new illumination has made wonderful progress since the report of last year and every department of the business has been affected—most, if not all of them, favorably."

The effect of the tungsten lamp on revenues is discussed at some length. The flaming arc has made decided progress during the year. At first regarded somewhat as a fad and rather as a monstrosity, limited in use to a few localities and a few buildings, the flaming arc is carving out a larger demand than ever, just at the moment when under the newer conditions of struggle the arc might well seem to be going to the rear as a back number and as material for the scrap heap.

The magnetite lamp is considered under the same heading and the cost of installation and maintenance of these in a few typical cases is given.

Under New Lamps and Illuminants, the Helion lamp, the new Nernst lamp fixtures and the Moore tube are briefly touched upon.

THE LAMP COMMITTEE; *W. W. Freeman, Chairman.*

As to the use of different types of lamps, the carbon filament is still the standard, although more than 60 per cent. of the companies reported are using a considerable proportion of gem lamps, and several of the larger companies are to abandon carbon lamps and furnish only gem lamps for their free renewals the coming year. About 75 per cent. of the companies reported are using tungsten lamps, and only about 20 per cent. tantalum lamps. Most of the companies that have furnished carbon lamps on a free renewal basis are doing the same with gem lamps.

After giving some data on the practice of making lamp renewals, the report ends with some general observations.

Miscellaneous

LAMPS FOR RESIDENCE ILLUMINATION; THEIR CHARACTERISTICS AND COMPARATIVE ECONOMY OF OPERATION; *by A. C. Scott.*

Presented at the Fifth Annual Convention of the Southwestern Electrical and Gas Association.

The paper contains a large number of facts and figures concerning the various types of both gas and electric lamps suitable for resident lighting. It is remarkably free from prejudice, and gives the information which all illuminating engineers should have, and in a manner which is comprehensible to most laymen. While it naturally contains no new matter, it is an exceptionally good review of the present state of the art.

TUNGSTEN VS. OTHER FORMS OF STREET LIGHTING; *by C. L. Sherwood.*

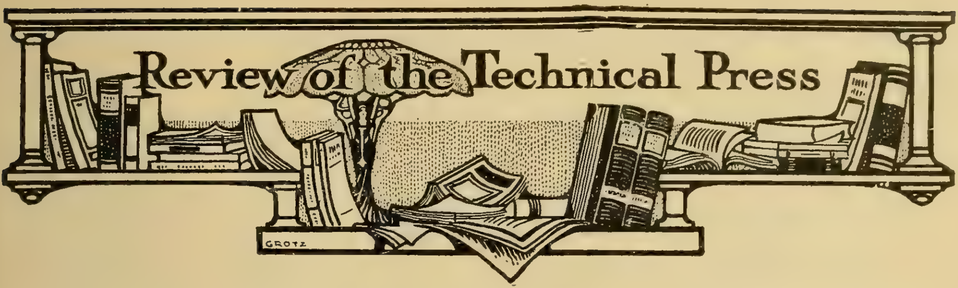
Presented at the May meeting of the Los Angeles Section of the American Institute of Electrical Engineers.

A brief exposition of the advantages of tungsten over the carbon lamp for street lighting.

ORNAMENTAL CURB LINE ILLUMINATION; *by D. F. Fradette.*

Read before the Iowa Electrical Association.

Describes the ornamental systems in Des Moines, Los Angeles, Oakland and Denver.



American Items

A New Phase of Street Lighting, by Henry A. Cozzens, Jr.; *Southern Electrician,* June.

A description of the installation of flaming arcs recently put up in Newark, N. J.

Why Laboratory Efficiency of a Lighting Source Differs from Efficiency of Illumination, by A. L. Eustice; *Electrical Review and Western Electrician,* May 29.

In this article Mr. Eustice sets forth the general principles which have formed the basis of his recent extended investigations along this line. The following are extracts:

The great advance in the efficiency of modern illuminants and the application of same to the requirements of commercial practice have not only resulted in a more careful study and analysis of the existing lighting situation, and thereby advanced the art of illumination, but also have educated the lamp buyer, in a great measure, to the real difference which exists between light and illumination. The result of the vast amount of energy which has been spent in this direction is an ever-increasing demand on the part of the purchaser of lighting equipment for comparative figures of total operating costs (materials, labor and current) based on an equality of illumination when the system is operating under conditions of commercial maintenance.

When the time comes, therefore, to buy illumination, on the basis of illumination actually produced, as has already been done in a few important installations of lighting systems, the working efficiency, or average illuminating results, will be of far greater importance than the laboratory efficiency of the individual units employed in the system.

While the candlepower performance curves of individual units are recognized to be invaluable to the illuminating engineer in setting forth a tentative scheme for the layout of a new installation of lighting equipment, the information presented in such curves is confined to the efficiency of the light source—that is, the efficiency of transformation of electrical energy into light, and, further, when the same is operating under more ideal conditions than ever exist on commercial circuits.

That the working efficiency of a system does not necessarily depend entirely upon the efficiency of the individual unit employed can be proven with no lengthy argument when consideration is given to the many other determining factors which enter into the problem, for it must be borne in mind that to obtain efficiency of illumination, there is required not only a knowledge of lamp efficiency, but also efficiency of distribution, of application and of visual perception.

It is logical, therefore, to conclude that an indication of the commercial performance of any unit should be derived by commercial, rather than laboratory, tests, in which all of the units are operating under commercial conditions, so that the common causes of difference outlined above are eliminated to a great extent and which further take into consideration the effect of surroundings. Such practical tests show, not what a lamp theoreti-

cally should do, but what the lamp actually does when operating under normal service conditions.

Illumination, June.

Principal articles are as follows:

Descriptive Article on Fixtures; From an Eastern Viewpoint (concerning the proposed association of the fixture manufacturers); Quality or Price—Which? The Building of Art Domes; A New Thermal Electric Lamp; What a Western Man Says on Organizations.

The editorial page is devoted to a strong presentation of the advantages to be attained for the fixture trade and allied arts by organization.

The following are excerpts:

As everybody in the gas and electric fixture business fully realizes, without organization nothing but ruination stares the business in the face. Prices have been cut to such an extent in the mad struggle for existence that many firms in the gas and electric fixture business are on the verge of bankruptcy. They know it—the trade generally knows it—and still they go on knowing positively that nothing awaits them but ruination. Why hard-headed men of ordinary business intelligence can stand by and see their money and their time being wasted through "cut-throat" methods is beyond our comprehension. The large manufacturers complain of the sort of competition they have to meet in submitting bids—as against "The Hole in the Ground Assemblers" that abound so plentifully all over the country and who "dub" themselves manufacturers; and we agree with the legitimate manufacturer who has a large plant and turns out a high grade of goods and pays his workmen a fair wage and employs the best of skilled labor, both artistic and mechanical, that money can procure that it is hard to compete with "The Hole in the Ground Assembler" of fixtures—because "These Pirates" of the fixture business can procure various parts for assembling a fixture—and in some cases that we know of—from identically the same men, at identically the same price, as does the legitimate manufacturer. And furthermore, our Mr. "Pirate Assembler" has very little, if any rent to pay, nor does he pay any salary, because of the fact that these "assemblers" are parties who work in the basements of their homes and use the women folks of their family, together with child labor, to produce a fixture. This statement, no doubt, will cause a great deal of comment by the manufacturer of the special designs and finer grade of goods; but the fact remains, nevertheless, that if you take away the profit from the cheaper lines of goods of the legitimate manufacturer, he will wake up and find that there is no profit for him at all in the higher grade of goods, because he has to continually contend against the price quoted for these "basement-made" fixtures. There is a recourse and protection for the legitimate manufacturer, and he should take means of obtaining what is justly his by right. What other large enterprise or manufacturing business would tolerate such a state of affairs? We venture the assertion none. As long as the men who are supposed to be the brains and intellect and the "Financial Gibraltars" of the gas and electric fixture business sit idly by and allow these "pirates" to take away from them the fruit of years of labor, just so long will the business of the gas and electric fixture business be one of discontent and unprofitableness.

Lighting Conditions at Atlantic City; *Electrical World,* May 27.

Detailed description with illustrations of the new street lighting system recently installed; also shows a number of the large electric signs along the boardwalk.

Business Street Illumination by Merchants' Associations in New Jersey, Wm. H. Steuart, *Electrical World,* May 27.

Treats of the street lighting installations in Newark, Jersey City, New Brunswick and Perth Amboy.

Street Series Tungsten Lamps Burned at an Angle, by George R. Hanchett; *Electrical World,* June 24.

Mr. Hanchett relates an experience with series tungsten lamps placed at an angle of forty-five degrees. He found that the filament soon dropped into a nearly vertical position, which it continued to maintain without trouble or loss.

The
Illuminating Engineer

Vol. IV AUGUST, 1909 No. 6

PRINCIPLES

"Despise not the day of small things."
OLD TESTAMENT.

The larger portion of the social fabric is included in the great middle class—those who are neither very wealthy nor very poor. The majority of lighting installations must be designed for the use of this middle stratum of society, and will have neither the gigantic nor intricate features of the modern sky-scraper nor the squalid meagerness of the tenement. The small store and factory, the modest home, the unpretentious hotel and public building, must always constitute a major portion of the problems in illuminating engineering.

But because a lighting installation is small it must by no means be inferred that illuminating engineering principles do not apply. The use of a single coal oil lamp or tallow candle may agree with or transgress the principles of illuminating engineering as completely, within the limits of its use, as the most elaborate installation of the latest forms of electric lamps. Principles are fundamental, eternal, and universal. Actions based upon them, whether consciously or unconsciously, are as infallible as the Pythagorian proposition, whose truth may be demonstrated by the laws of geometry or arrived at by the simplest measurements of elementary arithmetic.

The fallacy is often promulgated that results obtained by practice or "common sense" are wholly independent of, if not in actual contradiction to, the underlying principles involved. Nothing could be wider of the truth. Common sense is only unconsciously acting according to principle.

Let us not fall into the error of assuming that illuminating engineering principles apply only to elaborate and expensive installations. Wherever light is used the principles of illuminating engineering apply. Let us heed the ancient advice and despise not the day nor the doing of small things.

E. L. Elliott.

THE CARNIVAL OF LIGHT, MARKET STREET, NEWARK, N. J.

The "Carnival of Light" Realized

In the May issue of THE ILLUMINATING ENGINEER the suggestion was made that a festival be held once each year in the different cities, which should be given over to a general public exhibition of the wonderful possibilities of modern illumination. To our enterprising next door neighbor, Newark, New Jersey, belongs the honor of having first instituted the custom. On the evening of July 14th the magnificent new installation of lighting on the principal portion of one of its chief business thoroughfares was put into commission. Although this installation had its origin in a club of the business men of this particular street, the event was made the occasion of a general public rejoicing, which received the stamp of official approval by the participation of Mayor Haussling in the opening ceremonies.

The section of street illuminated reaches from the Pennsylvania Railway Station to the Court House, a distance of 10 blocks. It is traversed by all the city and suburban car lines and is naturally the principal artery of traffic in the city.

The installation consists of fifty-eight flaming arc lamps, supported on poles placed along the curb at a height of 25 feet, the average spacing between the poles being 125 feet. A night view of the street, shown in the accompanying illustration, gives a fair idea of the uniformity and brilliancy of the illumination produced. In anticipation of the inauguration of this lighting system, the various merchants and property owners along the way vied with one another in seeing who could produce the most fascinating or the most memorable effect in the use of artificial light. These efforts varied from the gorgeous electric signs and devices displayed by the large retail stores to the

equally impressive and more unique exhibition displayed by one merchant, who showed a single tallow candle burning in the window of his store, with the legend "one candle power." Roughly speaking, the light of the fifty-eight flaming arcs amounted to 2,000,000 candle power, and, although the single candle might assist, it could scarcely carry the mind over the practically infinite interval between one and two million; the flood of light on the street was simply beyond measurement by so small a unit. It is a curious and remarkable thought to revert to the fact that only so far back as the days of our grandfathers this tiny light was the principal source of illumination.

It is estimated that at least 150,000 spectators lined the street on the opening evening to enjoy the brilliancy of the spectacle as a whole, to compare the numerous devices set up for their entertainment by the merchants, and to make merry among themselves with that degree of abandon and good natured frolic which goes so far toward unbending our overstrained nerves and energies and making us realize that "we are all children of a larger growth."

Besides the general jollification in the streets by the spectators, who had come in from the surrounding cities and towns, and even New York itself, there was speechmaking in the assembly rooms of the Business Men's Club, in which congratulations upon the highly successful outcome of the undertaking and "honor to whom honor was due" in conceiving and carrying out the plans were heartily given and received.

A few remarks that were passed are of more than local interest. The Mayor of the city said: "This celebration will be heralded throughout the country; newspapers will publish it far and wide; people who read of it will say that Newark is an enterprising city; persons who contemplate moving will turn their eyes to Newark; they will say, 'That is a city that is going ahead,' and they will come here and live. It is the greatest thing for Newark that has happened during my administration." These remarks are no mere rhetorical flourish, but hard, sound sense.

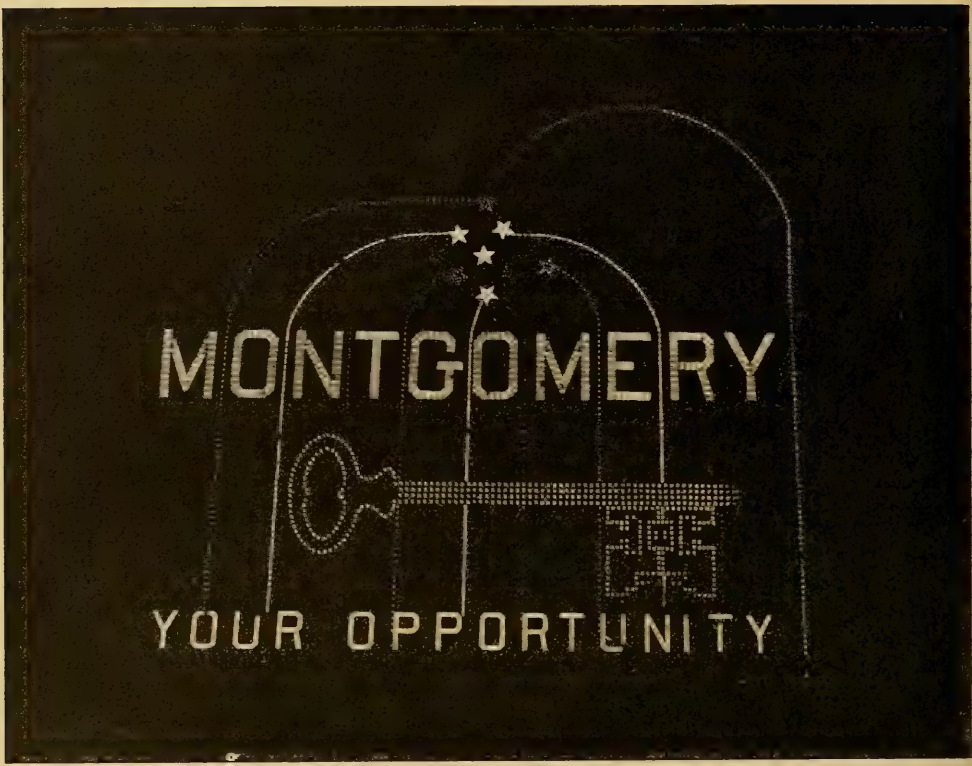
Another speaker referred to the fact that the street needed better paving, and that this would come. He is equally right. A badly paved, but well lighted, street is a contradiction which no enterprising city will long tolerate. Another speaker urged the property owners to erect better buildings and tenants to urge this upon their landlords; and so the march of improvement goes on. A merchant on the street said that his sales had already increased 25 per cent from the increase in private illumination which had been put in anticipatory of the better general lighting.

The special illumination and informal festivity was continued for four days, thus constituting in effect, if not specifically by name, a real "Carnival of Light." THE ILLUMINATING ENGINEER extends its most hearty congratulations upon the signal success of this first realization of its suggestion to the enterprising citizens forming the Market Street Merchants' Association, which conceived the scheme and carried it to completion; to the Public Service Corporation of New Jersey for its hearty co-operation; and to the Mayor and citizens of the city for the interest and appreciation shown to this public enterprise.

The Market Street installations above described may be said to furnish part second of the general plan now laid out. Part first was the illumination of the portion of North Broad Street previously described in our columns. A similar installation will be put in South Broad Street. The finished plan will therefore form a cross of the two intersecting streets, and the Newark papers have already hit upon the phrase, "Newark's Great White Cross."

There is a curious coincidence in this case between Newark and Philadelphia. The latter city is also working on a general plan of illumination which involves the lighting of portions of *its* Market Street and North and South Broad Streets, and the Philadelphia *Press* fancifully conceived airships being guided by this luminous "sign of the cross."

From this demonstration of the value of better street lighting it is a foregone conclusion that improvement will spread out in all directions through both cities.



CITY SLOGAN—MONTGOMERY, ALA.

"Montgomery—Your Opportunity"

Another public celebration in which illumination was the occasion and object took place in Montgomery, Ala., on July 20th, when the unique and beautiful electric sign bearing the above legend was presented to the city by the Montgomery Light and Water Power Company, and accepted on behalf of the city by City Attorney McIntyre. The motto or slogan for the sign was the result of a general contest under the auspices of the lighting company, and was won by Mr. Gordon McKinley. The emblem of the key originated with Miss Anita Strassburger.

The sign contains 2600 electric lamps, and the supporting structure is 85 feet long and 75 feet high. The sign is of a spectacular order. The key stands out prominently in red; a sky-rocket ascends, and as it bursts into a shower of falling stars the word "Montgomery" appears; and as the shower descends, the words "Your Opportunity" is flashed out.

The most noteworthy feature of the event is the fact that this sign, expensive to install and to maintain, is the free gift of the lighting company to the city. While this gift will unquestionably prove a case of bread cast upon the waters coming back buttered, it nevertheless shows a highly commendable spirit on the part of the lighting company to take the long sighted view of its relation to the public, and to bank upon the city's future prosperity. Progress to the city means progress to the lighting company. Those who habitually seek for selfish motives in the actions of public service corporations may say that this is only an ingenious scheme of furthering the company's own inter-

ests; but if every business man and corporation would act upon the theory that in promoting the welfare of all they will inevitably reap their own share of the prosperity, our cities would all be more prosperous and possessed of a better feeling of mutual helpfulness and co-operation. A lighting company is in a position, from the nature of its product, to set the pace and lead the race in public improvements; and the example of the Montgomery Light and Water Power Company is one that may well be heeded.

The initiative of this particular instance is due to Mr. George Williams, and those who have followed the admirable work which Mr. Williams has done in connection with the promotion of good lighting in numerous cities throughout the country will at once recognize the spirit of his policy embodied in this impressive spectacle.

A Masterpiece of Spectacular Lighting

Advertising takes various forms and involves different expenditures of money, brains and labor. It originates in the two strongest and most deep-rooted desires of civilized man—with the single exception, which need not be categorically stated—namely, the desire for fame and wealth. "The race is not to the swift, nor the battle to the strong, nor riches to men of understanding," said the preacher, "but time and chance happeneth to them all." The power of advertising had not been developed at the time this observation was recorded; to the persistent advertiser not even the exigencies of time and chance can prevent the winning of fortune and fame. Except possibly the President and ex-President, whose faces are most familiar to the American people to-day? Those of its few general advertisers who use their portraits in their advertising. Who does not know Mr. W. L. Douglas by sight? And of the millions who recognize him, how many know him as the ex-Governor of the Commonwealth of Massachusetts?

These philosophical opinions are not here set forth with any cunning ulterior motive, but were suggested by a photograph of one of the most striking and original pieces of advertising that the world has ever produced. The Singer Tower, as it is familiarly called, will long stand as a monument to the genius of the corporation which has made its own name a household word throughout the civilized world. While at least one other higher tower has since been erected, and others yet higher are progressing toward realization, the Singer Tower will stand as the embodiment of daring originality in building construction combined with advertising publicity. It would not be expected that those capable of such a stroke of genius would for a moment consider allowing the darkness of night to pull down the shutters over this sky-piercing show window. On the contrary, it is when night has furnished a background containing no distracting details that the opportunity for the most spectacular effect arises.

As modern mechanical science had made the construction of the tower possible, so have modern light-sources made it possible to project the tower against the horizon as a pillar of light. Without doubt, in point of boldness of conception and extensiveness of lighting equipment, this is the most magnificent piece of spectacular lighting that has ever been consummated. The tower rises twenty-six stories above the roof of the main building, of which it is a part. The walls are of red brick with light gray terra cotta trimmings, and an abundance of windows. It would have been a comparatively easy task to have "outlined" the architectural features with strings of incandescent lamps, after the usual manner; in fact, the design of the tower is peculiarly well adapted to such treatment. But that sort of lighting had been done before, and on a magnificent scale; and furthermore, the most bewildering examples of the kind in the world were close at hand—Coney Island. While such decoration would have made the tower conspicuous, it would not have differentiated it from "Dreamland" and its thousand and one

NIGHT ILLUMINATION, SINGER TOWER, NEW YORK.

imitators of less degree. Unlike so many others having lighting problems to solve, the company did not believe in letting a hundred dollars stand in the way of securing the best effect on a million dollar building. In fact, it was not a question of cost at all; the only question was how to make this tower such a conspicuously beautiful spectacle at night that it would do justice to the name and fame of the company.

To illuminate a red brick tower twenty stories high so that it should stand out as a column of light, without the light-sources themselves being seen, was a problem calling for the utmost of illuminating engineering skill. The tower rises from nearly the central part of the main structure, and the roof of the latter furnished available locations for searchlights, which could be of the most powerful type constructed. On the Broadway side, however, the tower stands comparatively close to the building line, thus bringing the searchlights close to the surface against which the rays were to be projected. Thirty-one searchlights with 18-in. lenses are used in the installation,

each consuming 35 amperes of current at 110 volts. The intensity of the beam thrown by these searchlights is said to be 130,000,000 c.p. There is a special 30-in. searchlight, giving a beam of 200,000,000 c.p. intensity, which is made to play upon the flag floating from its staff on top of the tower.

Besides the deluge of light from these projectors there are also 1500 16 c.p. incandescent lamps with reflectors, so disposed about the tower that the lamps themselves are invisible from below. It is the purpose of these units to even up the illumination. The lenses of the searchlights are made up of sections, each calculated to distribute the light uniformly over a definite part of the surface of the tower. The beauty of the whole scheme, as will readily be appreciated, depends upon the evenness of illumination; and after the most careful calculations to predetermine the position and character of the light-units, it has required numerous experiments and persistent efforts to reach the end desired.

A general view of the tower and its surroundings is shown on the front cover, and a nearer view of the tower itself in the accompanying illustration. The uniformity in the illumination obtained is truly remarkable.

The Colossus of Rhodes was one of the seven wonders of the world, and our own Statue of Liberty Enlightening the World was intended to give the first welcoming gleam to the citizen returning to his native land and the immigrant seeking the freedom which the statue typifies. But even the brilliant imagination, the soaring ideals, and the consummate engineering skill for which France has ever been noted, seconded by the co-operation of the American people and their Government, have been eclipsed by the efforts of a private corporation to advertise that humble but most useful and respectable domestic necessity of Yankee invention—the sewing machine. It is the majestically beautiful Singer Tower that first greets the mariner as his vessel nears the metropolis of the Western continent.

Opportunities at the Massachusetts Institute of Technology for Students Who Wish to Become Illuminating Engineers

By Geo. C. Shaad.

The Massachusetts Institute of Technology, in addition to offering regular general courses in the larger branches of engineering, affords abundant opportunities to students who wish to prepare more especially for some particular line of work, such as illuminating engineering. The first years of all the undergraduate courses in engineering at the institute are devoted largely to a thorough grounding in the fundamental subjects of physics, mathematics, mechanics and chemistry. In the third and fourth years the more professional subjects are introduced. On account of the important part played by electricity in illumination, students wishing to become illuminating engineers should preferably be enrolled in the department of electrical engineering.

The present undergraduate course in electrical engineering involves, along the lines of illuminating engineering, a certain amount of required work in the photometric laboratories sufficient to instruct the student in the fundamentals of photometry and to give some skill in making photometrical measurements. A special course in illumination and photometry, which will be made elective in the fourth year, is about to be introduced. This course will consist of lectures, recitations and additional laboratory work. Work in this course is not to be limited to the electrical sources of illumination, but is intended to cover all practical illuminants and their applications. The selection of a subject for investigation for a graduation thesis is optional, and the department facilities and equipment are such that the study of special problems

in illumination or the investigation of lighting sources may be readily carried out.

To the graduate student the adequately equipped laboratories of the electrical engineering department and the departments of physics and chemistry are available for use in the special investigations which form a large part of the graduate courses as they are offered at the institute. He may choose suitable illumination problems for his investigation and, in addition, may elect the general subject of lighting as a major, in which case a suitable course, consisting of lectures and assigned readings, is arranged to suit the individual requirements. Such courses in the department of architecture as he may be prepared to take are open for his election, and illumination from the architect's standpoint may be studied.

Three special rooms in the electrical laboratories are set aside for photometrical apparatus. One of these is permanently equipped with a photometer designed and built by the department for the study of light sources of high candle power, such as gas or electric arc lamps. A second room is fitted with a standard photometer bar and equipment in the way of lamp holders, photometer screens, standards of light, instruments, etc., and is used for all ordinary photometrical work. The third room is available, as are any of the special research rooms with which the laboratories are provided, for the mounting of equipment used in making special investigations which cannot be readily carried out by means of the permanently mounted equipment.

The institute laboratories are being continually used for the investigation of problems in illuminating engineering which arise in the commercial field, and every effort is made to keep the equipment for this class of work entirely adequate. Work recently done by students or members of the instructing staff covers such subjects as studies of the Nernst lamp; flaming arc lamp developments; theater lighting; the effect of surface conditions on the luminous radiation of tungsten filaments; photometric measurements of street illumination, etc. At the present time the first complete tests of the high pressure gas arcs to be made in this country are being carried out at the institute. It is interesting to note that a three-mantle arc of this type has developed in the neighborhood of 4000 c.p.

The Office of the Omaha "Bee"

If you should ask of an Easterner what Nebraska is celebrated for, he would probably answer: For a Presidential candidate who holds the record for long distance running and a daily newspaper called the *Bee*. Notwithstanding the record of the candidate, the *Bee* has actually been running longer; and though some may be skeptical on this point, it will probably continue to run long after the candidate has ceased sprinting.

The Omaha *Bee* is a great paper. It is a prophet having honor in its own country, as well as recognition throughout the land. Its hive is a magnificent building, which is noteworthy for the originality and clear-cut motive of its architecture, both exterior and interior. The lighting fixtures partake of these same admirable qualities. A view of the general office is shown herewith. Before commenting on the lighting, let us call attention to the effectiveness of the decorative treatment, which is like a breath of fresh sea air after the heavy atmosphere of a crowded building. There is neither fluted column nor Greek capital nor Gothic arch nor French rococo; and yet behold the simple, pleasing, invigorating effect of originality, produced in defiance of the traditions which so generally hold our present ideas of decorative art in bondage.

The illustration shown is an example of the lighting of the general offices. The fixtures are wooden standards corresponding in material and design to the counters and the general decorative scheme. Each consists of two quite distinct parts, one for the purely decorative lighting and the other for the practical illumination. The latter consists of four electric lamps, hav-

OFFICE OF THE "BEE," OMAHA, NEB.

ing large frosted round globes hanging pendent from the four simple wooden cross-arms at the top of the standard. The only metal decoration is the bronze husk covering the necessary socket and holder. Above this is a canopy of leaded glass showing designs in harmony with the mural decorations. This contains four ordinary 16 c.p. lamps. Beside the beauty of color and design in the glass itself, this canopy serves to produce a very mild general illumination by indirect lighting from the ceiling, and also to light the ceiling sufficiently to prevent any feeling of gloom. Individual desk lights are provided for the clerical force.

A Novel Illumination of a Church

At a prominent society wedding which recently took place in Montgomery, Ala., a lighting effect was produced which probably is the first of its kind ever attempted. The novelty of the scheme consisted in placing four flaming arc lamps on the outside of the church, near the stained glass windows and covering the installation with white canvas. The method of operation is shown in the illustration. The decoration of the interior of the church was carried out on an elaborate scale and involved the use of many incandescent lamps; but the crowning feature of the whole affair from the decorative standpoint was the turning on of the arc lamps, which gave the effect of the sun rising and shining in through the windows. It is thus described in a local paper:

Lights were arranged on the outside of the church at each stained glass window, and the light was reflected inside. At the be-

SPECIAL CHURCH ILLUMINATION, MONTGOMERY, ALA.

ginning of the ceremony, all of the other lights in the church were turned out, and only these were used. The scene was as one at sunrise, the lights changing from a soft mellow glow and gradually growing brighter and brighter, until when the ceremony was over and the young couple were pronounced husband and wife, the lights burst forth in great splendor, as the rising sun on the dawn of a new life.

Distance Control of Gas Street Lighting in England

(*Concluded.*)

By James A. Seager.

It is now necessary to give some brief description of the various styles of automatic controllers, starting with the clockwork type. The "Gunfire" controller, manufactured by the Automatic Light Controlling Company, Ltd., of Bristol, is of very simple mechanism, can be adopted with any existing class of burner or lantern, and can be trusted to the ordinary workmen who clean the lanterns. Each lamp is dealt with separately without interference with the ordinary pressure, and Fig. 3 shows the general appearance of the controllers. It virtually consists of a clockwork device, having stops set upon it, which, when brought into contact with a star wheel attached to the cock on the gas supply, turn the cock in a uniform direction of rotation, so as to turn the gas alternately on and off. The operation of winding and setting a controller is very simply effected, as all the parts


FIG. 3.

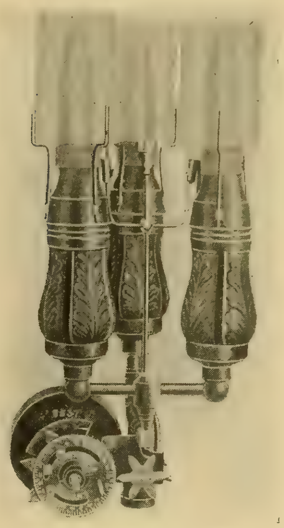


FIG. 4.

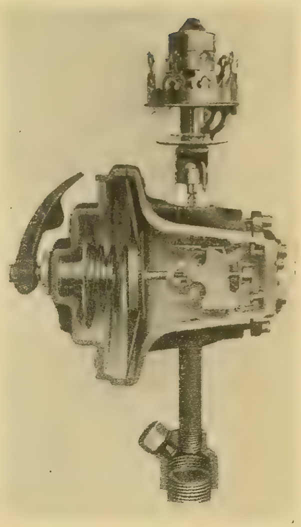


FIG. 5.

necessary to be touched are in full view when the controller case is opened. The whole apparatus is adaptable to be fixed on the old lamp post, and is used either for ordinary vertical mantles, or for the inverted type. The patent controller box prevents the controller from being tampered with by mischievous persons and protects the gear both from the weather and the heat and fumes of the gas. It is found that with this system one man can more easily attend to 250 lamps than he could eighty with torch lighting, even if it is required that he should see that every lamp is properly lighted at lighting time, because the system provides that he shall wind and set the controllers and clean the lanterns in the day, and cycle round to see that all is in order at lighting time. A further extension of this controller is shown in Fig. 4. In this case the device automatically lights all the burners in a group at dusk, extinguishes the majority at or about midnight, and the final light or lights at dawn.

Turning now to the pressure control type of apparatus, Fig. 5 shows very clearly the internal arrangements of the "Bamag" controller, the view being shown in sections. It consists of a diaphragm which moves within the limits of its greatest force, development being controlled by an air brake or cushion in the interior of the apparatus regulating the movements; in this way sudden and unexpected pressures from within as well as without are obviated. In order to control the gas wave a valve and seat independent from the other parts of the apparatus are provided, this valve remaining unaffected by temperatures and other influences of the apparatus. The face of the "Bamag" lighter is provided with a movable pointer in front of the dial, by means of which the distance lighter can be set to operate at any given or desired pressure by means of altering the force of the spring pressing on a diaphragm; at the same time this pointer serves to take pressures (at any time) of the lamps for by moving the pointer in one or other direction the gas is ignited. The point of ignition shows the actual pressure, which can be read off the dial, graduated in tenths of inches. By fixing the pointer on a correspondingly higher pressure to operate it in future the adjustment of the "Bamag" lighter is accomplished. It is possible to construct the lighter for the most varying conditions and adaptable to almost any requirements, including the working or with two, three or four waves during the twenty-four hours. For example, it is possible to light all the lamps simultaneously in the evening, extinguish

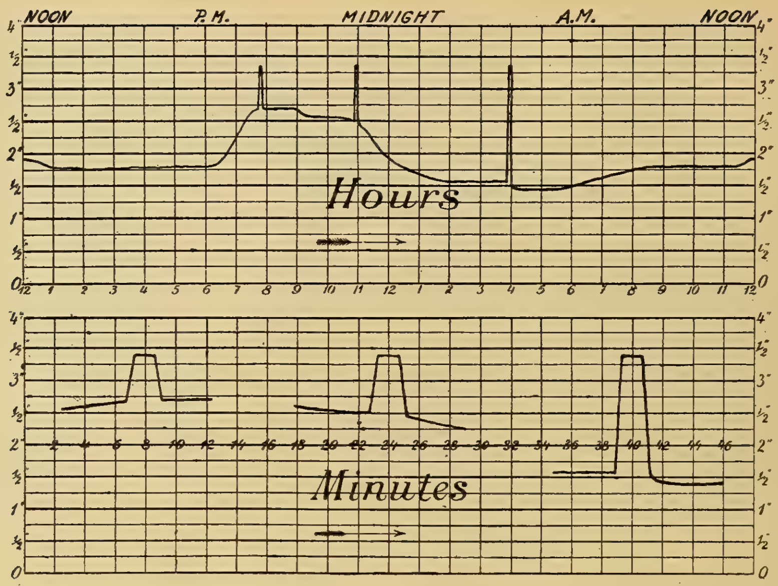


FIG. 6.

some at 11 p. m., others at midnight and the remainder in the morning. Again it may be required that some gas lamps may be relighted after electric lighting of the streets has been discontinued, or in the early morning part or all the lamps may be relighted for a short time when the early workmen go to their factories. Fig. 6 shows a typical form of pressure chart for a town, and the three sharp peaks indicate the momentary pressures placed upon the mains in order to operate the diaphragms of the controllers. These pressures are set sufficiently high to obviate any interference with the lighting or extinguishing of the lamps by accidental fluctuation of pressure in the ordinary supply.

A considerable amount of attention has lately been paid to the "Rostin" apparatus, which is being developed by Mr. A. Landsberger, of Cannon street, London, E. C. This is illustrated in Fig. 7. The gas for lighting the burner passes from the stand pipe through the tube "A" to the cock "B," without going through any part of the apparatus, the latter being supplied with gas through a separate cock "C." The plug of the cock "B" is controlled in such a way that each step of the ratchet wheel attached to it corresponds either with a blank or open port, and is turned in one direction only. This turning is secured by means of the levers

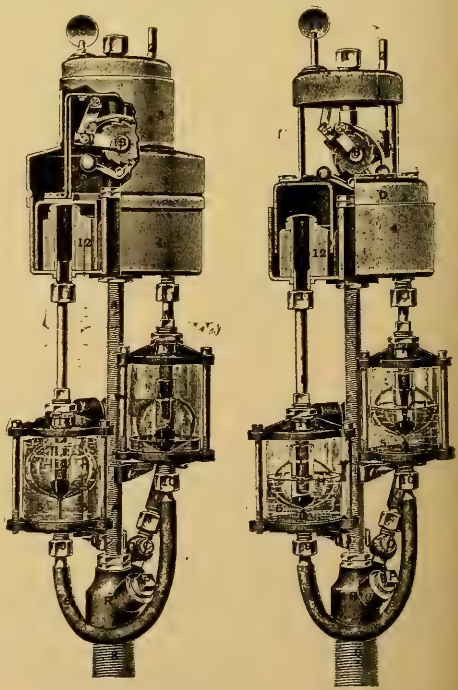


FIG. 7.

shown in the diagram, actuated by a bell "D" sealed in mercury "E." The bell only turns the cock when rising and does not alter its position when dropping. The inner room of the bell is connected with an inlet valve "F" and the outlet valve "G." These two valves represent a form of water gauge, the two arms of which are widened, as shown in the diagram, to a kind of vessel. Each of the latter contains a float "H" and "I," each float containing the small mercury seal. This water gauge arrangement is filled with a non-freezing, non-evaporating mixture of glycerine and water, and when the gas is turned on at "C" it passes through the tube "K" into the inlet vessel "F," and causes the level of the liquid to come down. The liquid in "G" will rise in accordance with the hight of pressure obtained, and can be read from the difference in the two levels, as on an ordinary water gauge. When the liquid in "F" and "G" moves up and down the floats "H" and "I" move accordingly when they become buoyant. These valves are adjusted in accordance with the pressure prevailing at the stop, where the apparatus is to be fixed, so that the inlet valve "F" unseals at, say, 35/10ths, while the outlet valve "G" would seal or unseal, say, at 30/10ths. As long as the pressure remains below 30/10ths the inner room of the bell "D" is in connection with the atmosphere through the sealing tube "M" and the vent "N." When the pressure reaches 30/10ths this communication is interrupted and on the pressure rising to 35/10ths the inlet sealing tube "L" becomes unsealed, allowing the gas to pass into the bell "D" acting underneath it with a power equal to the *full* pressure and not the *difference* of pressure of the gas, thus lifting it and turning the cock. Any rise of pressure above the limit does not matter, because the bell remains up, and the reduction of pressure does not affect the apparatus until the unsealing point of the outlet has been reached, when the inlet, which was adjusted to 35/10ths, will have sealed and the gas in the bell can escape through vent "N," allowing the bell to drop. Should the pressure drop to 31/10ths only and rise again to 35/10ths or over, the apparatus cannot be affected, because the gas which had got into the bell when the inlet was previously unsealed cannot escape out of the bell. This is important where the consumption lowers the pressure after lighting time, and where the pressure will rise again before midnight, when the apparatus is not supposed to work. The two valves "F" and "G" are both adjustable independently of each other, so that the rising and falling of the bell is under perfect control and any adjustment can be chosen from a difference of 2/10ths up to any large margin.

The lifting force of the bell is increased by a leverage of three to one, so that the actual power brought to bear on the cock "B" often amounts to six or seven pounds. The ignition of gas takes place by a bye-pass, which is alight during the daytime only, and which goes out as soon as the plug supplies the gas to the burner. The adjustment to "F" and "G" allows the apparatus to work in any difficult place ranging from flat ground to hills and overcoming involuntary variations of pressure. If the inlet is adjusted so that the maximum night pressure which prevails at lighting time at a certain spot is in accordance with the ordinary night maximum given from the works, then no surplus pressure is required. The pressure diagrams have then only to be studied with a view to ascertaining what is the involuntary drop after lighting and the subsequent involuntary rise before the pressure is taken off at the works. This drop does not generally reach the line of the minimum pressure during the night, in such a case the outlet valve is adjusted half way between the minimum night pressure and the lowest point of the involuntary drop, consequently the bell does not drop while the pressure drops after lighting, but remains up, and therefore if the inlet unseals a second time the apparatus does not act. Where the pressure does not drop after lighting and rise again involuntarily, the apparatus can be adjusted so as to work with 2 or 3/10ths difference only. Where it is required to turn off, say, half the lamps at midnight and the remainder at dawn the cock is drilled in with alternate holes and blanks, but half of them are drilled

FIG. 8.

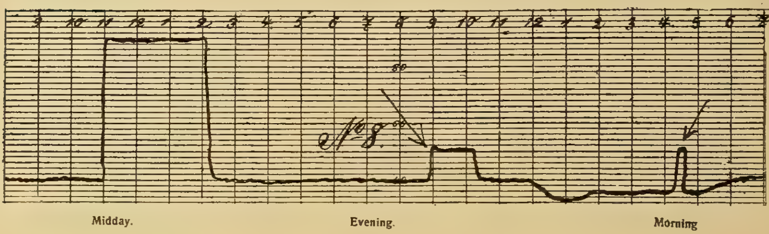


FIG. 9.

with hole, hole and blank, and the other half with hole, blank and blank. In this way the first movement of the ratchet wheels throughout the system lights all the lamps, the second continues the lighting of half the lamps and puts the other half out, by bringing half the blanks into operation, while the third brings all the blanks into operation and extinguishes the whole of the lights. In this way by special drilling of the cocks any unusual features in the pressure chart of a district may be overcome. To illustrate the point of keeping the actuating pressure within the ordinary evening pressure the diagram (Fig. 8) may be shown, the points of lighting and extinguishing being of lighting and extinguishing being shown by the arrows. It will be seen that the evening pressure exceeds the actuating points of the maximum without any damage. This by the way shows a street lighting system in which half the lamps are turned out at midnight and half at dawn.

Fig. 9 is interesting from the point of view of illustrating the way in which unusual features in the pressure chart are negotiated by means of the "Rostin" apparatus. In the particular town from which this diagram was taken it is the practice at between the hours of 11 and 2 to considerably augment the pressure in the system for the purpose of supplying gas stoves for cooking purposes, and it will be seen that this pressure is largely in excess not only of the pressure of the "Rostin" control, but even of the maximum evening lighting pressure.

It is impossible in an article of this description to mention, much less to describe, the large number of control gears which have been brought out for the purpose of automatic lighting and extinguishing of street lamps, but the above description of representative types indicates pretty fairly the direction in which modern practice is tending and the actual result of operations in Europe tends to show that both in diminishing the wastage of gas, in reducing the cost of labor and in decreasing the consumption of mantles, automatic control is a distinct advance upon the older method of manipulation. It is, therefore, a subject which American gas engineers can with profit to themselves investigate very carefully. It is doubtful whether some of the systems will operate satisfactorily upon gas containing a large proportion of naphthaline, but the general advantages of the idea are too obvious to be neglected.

Courtesy of Collier's Weekly.

CINCINNATI BASEBALL PARK BY ARTIFICIAL ILLUMINATION.

Baseball by Night

The fact that night baseball was to be tried in Cincinnati, Pittsburgh and Chicago was noted in a recent issue. The results obtained from the first trial in Cincinnati seem to indicate that the plan will be highly successful.

The illustration shows a night photograph taken of the Cincinnati grounds. The method of illumination is by the use of huge projectors, fourteen of which were used for the purpose; although it is stated that three of them were nearly sufficient to light the grounds. The lamps are of mammoth size, the carbons being 1⅜ inches in diameter. Alternating current of 235 volts is used. Two of the projectors are mounted behind each fielder on steel towers 100 feet high, while others are mounted on the roof of the grandstand and the covered bleachers. The lamps and installation were designed by Mr. George F. Cahill.

This marks another epoch in the enormous advancement of recreation made possible at night by the use of modern illumination. What the end will be in this direction is hard to predict. Horse racing by night would be a simple problem, and, in fact, has already been tried. Perhaps some of those afflicted with the disease called "golf" may find a way of turning illumination to account so that they will not be obliged to lose the half of the twenty-four hours in which they are not favored with sunlight. It is not impossible that artificial lighting might add some unique and fascinating elements to the game. A boat race in which the crews were followed by the "spot" of a powerful searchlight,

thus making their relative positions visible to spectators miles away, is another dream that might come to pass. He who would venture to set down the limits of the use of artificial light in providing additional facilities for recreation would need to have more than the ancient gift of prophesy.

Park Lighting at Oklahoma City

BY GLENN MARSTON.

STILES PARK, OKLAHOMA CITY.

Recently the Oklahoma Gas & Electric Company presented to Oklahoma City the equipment for lighting Stiles Park, one of several small circle parks at intersections of streets with the new twenty-six mile boulevard.

The equipment consisted of eight concrete posts, four carrying three globes and four carrying single globes. The posts are of reinforced concrete, hollow, and hexagonal in design, manufactured by the Hollow Concrete Pole Company. They are surmounted by ornamental copper caps, which carry the lights.

The lighting of the three globe posts consists of one upright 100 watt tungsten, and two 60 watt tungstens, suspended from 12 inch arms. The single globe posts are lighted with 100 watt tungstens. This lighting supplants one enclosed arc formerly hung from a 60 foot pole in the center of the park.

The popularity of the park has greatly increased since the installation, the present use being more than double the former attendance.

The residents of McKinley avenue have petitioned the council to install 100 watt tungstens on fifty-seven concrete poles now carrying the company's lines along that thoroughfare.

Practical Problems in Illuminating Engineering

Lighting a Barber Shop

It was remarked in one of the recent issues of THE ILLUMINATING ENGINEER that much might be learned from a study of some of the installations which had not been laid out by professional illuminating engineers, but which were giving results to the entire satisfaction of the user. Small installations are naturally less the province of the independent illuminating engineer than of the electrical contractor who does the wiring, and the case described below is one of this kind.

The floor plan of the shop is shown in Fig. 1. The floor area is 309 square feet. The ceiling height is 8 feet 10 inches, and what the illuminating engineer would probably call the "working plans"—namely, the height of the customer's face while being shaven—is 3 feet 9 inches above the floor. Ceiling and walls are of a light green tint, with glossy surface. In front of the chairs are the usual mirrors, consisting of three 5-foot sections.

The lighting installation formerly consisted of two two-light inverted mantle gas lamps with the regular half-frosted glass ball hung about 2 feet from the ceiling, the lamps being slightly farther apart

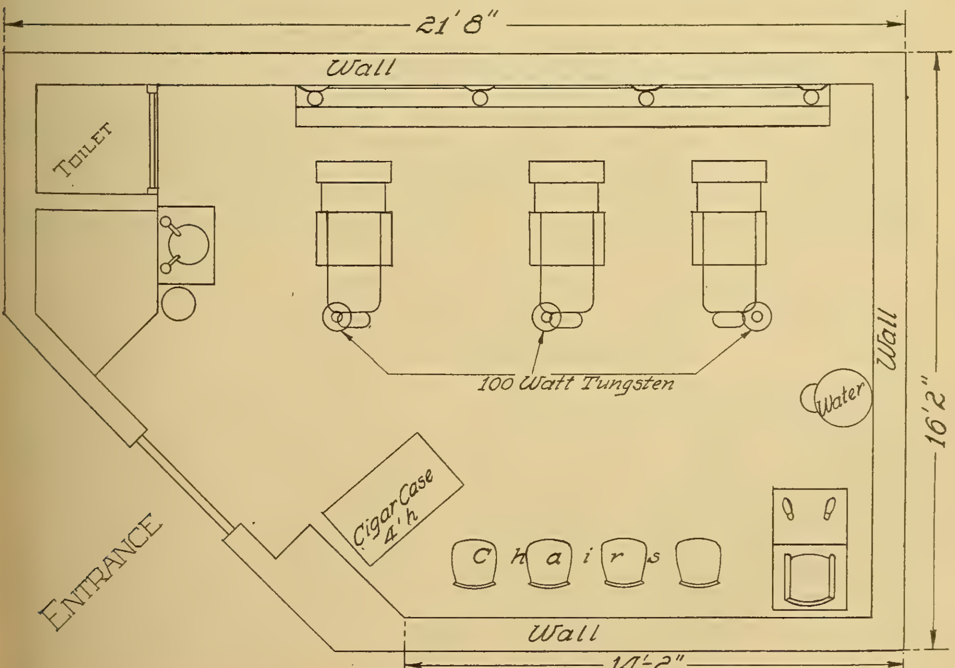


FIG. 1.

FIG. 2.

than the outermost electric lamps. This brought the lamps within 2 feet of the heads of the barbers working on the outer chairs, and according to the testimony of the proprietor were objectionable on account of heat in the summer.

The present installation consists, as shown, of three one-light 100-watt bowl-frosted tungsten lamps, fitted with concentrating prismatic reflectors, and supported by simple stem fixtures at a height of 6 feet 10 inches from the center of the lamp to the floor. The lamps are practically directly over the face of a customer while being shaven, as shown in Fig. 2.

According to figures published at various times, the lumens per watt, or the foot-handles per square foot per watt effective on the working plane in a room with light ceiling and walls from units of this kind, are 4; hence, dividing the total number of watts, 300, by the number of square feet, 309, and multiplying the result by 4, we would obtain, as the theoretical average intensity in foot-candles, 3.9. Uniform illumination, however, was not aimed at in this case, the most brilliant light being required for use by the barbers. The bowl type reflectors giving a wider distribution were first tried, and while the general illumination was more uniform, the barbers themselves were decidedly in favor of the concentrating reflectors, which gave them at least twice as intense illumination of the face of their customers—an intensity of probably 10 foot-candles or more.

While the intensity on the chairs of waiting patrons is not as brilliant as would be thought desirable for a reading-room, it is sufficient for the casual reading done by the patrons.

It is worthy of note that the present electric lighting system, which is entirely satisfactory in illuminating results, together with the addition of an electric vibrator, is operated at a cost not exceeding that of the former gas lighting equipment.

What Would You Do?

The critic is generally criticised for being *de*structive rather than *con*structive. The criticism, however, has less force than is intended, for reconstruction always involves destruction. The ground must be clear before new work can begin. There is limitless opportunity at the present time for criticism, both destructive and constructive, of lighting installations. The illustration shown here is a distinct type of hundreds of similar cases that exist in New York, and to some extent in other large cities. It shows the inevitable result of a city's growth, and the consequent expansion of the business district. Every city is built about a nucleus of business, and in the progress of its evolution this nucleus continues to expand and absorb the residential portion at its constantly widening outskirts. There are usually three steps in this metamorphosis: First, the private residence becomes the public

FIG. 1.

boarding or rooming-house; second, it is temporarily utilized for business or commercial purposes; third, it is razed and supplanted by a strictly commercial structure.

The photograph shows an instance in the second of these stages (Fig. 1). The room was once the parlor of a typical brownstone mansion; its dimensions are approximately 20 by 40 feet, and it receives its daylight entirely from two large windows in the front. The ceiling is of good height, probably 15 feet, and is decorated with the stucco center pieces, moldings and cornice which were the prevailing mode some 30 or 40 years ago, when the building was constructed. The woodwork is dark, either black walnut or a painted imitation. The parquet floor is probably a more recent addition. The room is piped for gas with three outlets in the ceiling, and one side bracket. The two additional drop lights in the front are plainly recent additions. The present use of the room is clearly shown in the picture.

Now, the question is, How would you light this room in the most satisfactory manner? Gas is already at hand, giving the advantage, at least in regard to first cost of the installation, to gas illumination; electricity, however, is to be had at the cost of the necessary wiring.

If the problem were put to you how would *you* do it?

The relative importance of the small installation is unquestioned, though often perhaps overlooked by the professional illuminating engineer. As the number of minor installations, however, must always constitute by far the larger portion of the total amount of illuminating engineering practice, it is our desire to give a due amount of attention to this part of the general field. To this end we especially request those having such work in hand to submit such problems for discussion in these columns, and likewise urge our readers to send in solutions for the problems given.

We desire that these shall not be theo-

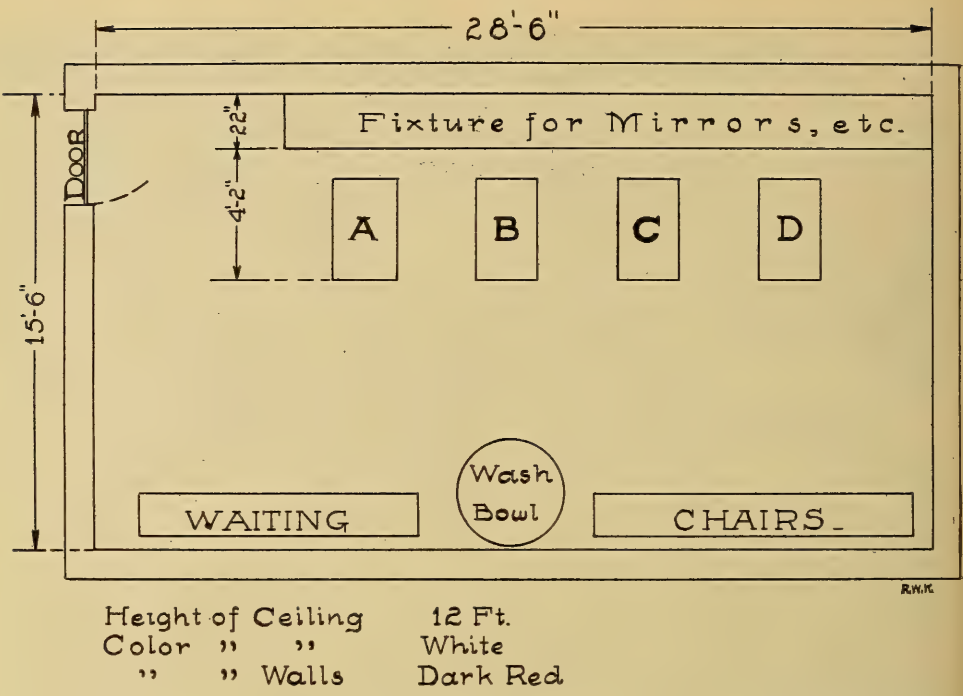
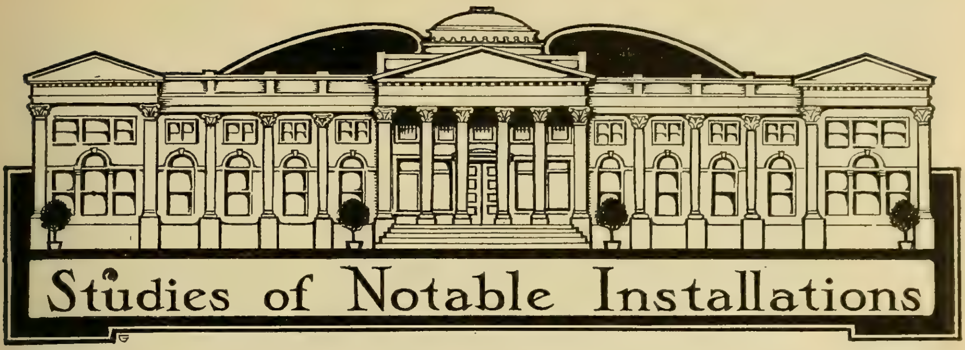


FIG. 2.

retical cases, but actual problems that have come up in the regular line of work. Let it be thoroughly understood, moreover, that no problem is too small, or too seemingly trivial to disqualify it for consideration. While the solution of the small problem may be simple, it is as important to the case in hand as that of the most elaborate installation.

We give above (Fig. 2) a problem submitted to us by an electrical contractor in one of the interior cities of this State. The room is to be used as a barber shop, and represents the average installation of this kind. The problem is apparently very simple, and yet there are not only several ways of giving it good illumination, but a great many ways of giving it very poor illumination. Plans for either gas or electricity, or a combination, are in order.

Solution of these problems should reach us by the 20th inst. to insure publication in our next issue.



The Seats of the Mighty

The dogma of the equality of man, whether social, political or intellectual, is a dream; but, unlike many other dreams, it never comes to pass. Such equality exists only in that fabulous golden age that is set safely back out of reach in the haze of antiquity, and in the rosy imagination of those choice spirits whose good will outruns their reason. Whenever you can go into a primeval forest and find every tree of equal size and strength, you may hope to find a civilization in which all men are equal; but so sure as you find one tree overtopping another, and one shrub crowding another to the wall, you may expect to find the human individual exercising dominion and authority of some sort over his fellows.

FIG. I.—OPEN AIR SITTING ROOM. HOUSE OF REGINALD C. VANDERBILT, NEWPORT.

FIG. 2.—ROOM IN HOUSE OF REGINALD C. VANDERBILT, NEWPORT.

FIG. 3.—BED CHAMBER, HOUSE OF REGINALD C. VANDERBILT, NEWPORT.

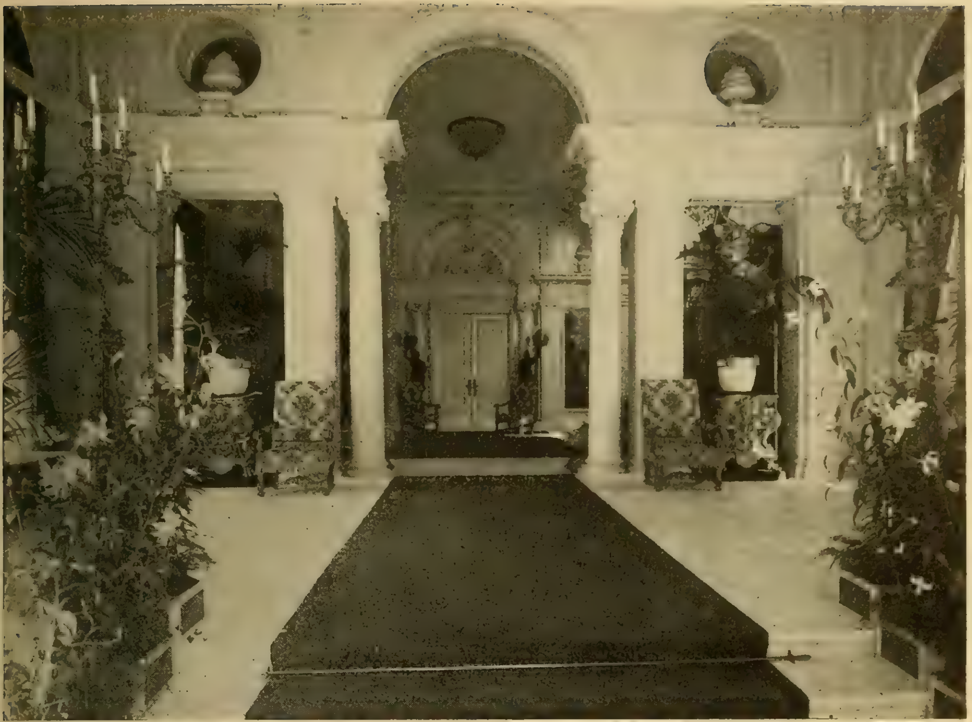


FIG. 4.—VESTIBULE, VILLA OF HERMAN OELRICHS, NEWPORT.

FIG. 5.—MUSIC ROOM, VILLA OF HERMAN OELRICHS, NEWPORT.

Without entering into the endless and fruitless discussion of *why* this is true, let us for a moment accept Pope's dictum that "whatever is is right," and divert our minds with a brief inspection, through the proxy of the photographic camera, of the mansions of some of those whom chance or merit has given social power. Two cities in this country stand pre-eminent as containing "Seats of the Mighty" in the social and financial world—New York and Newport.

Fig. 1 shows what might be called an open air sitting-room in the Newport residence of Mr. Reginald C. Vanderbilt. The whole air and spirit of the place is comprehended in a single word—simplicity. Nothing could be more unpretentious than the architecture and the furnishings, except the single ceiling bowl, which apparently is the entire source of artificial illumination. The demands for artificial light here are manifestly exceedingly limited. It is a place from which to contemplate the beauties of the landscape and to enjoy conversation or meditation, but not for reading or work.

Fig. 2 is another room in the same house and is the exact reverse in its general purpose from the room just shown. In its furnishings and arrangement everything invites to indoor pleasures. Note the two beautiful lamps on the table, and fancy with what luxury of comfort you could sit at the divan and read, with the light falling over your shoulder. There is no central chandelier or dome to annoy with its unusual direction of rays; the two torch-like brackets over the mantle are equipped with dense opal globes which will effectively protect the eye—but even these you may extinguish if you wish. If it is a matter of writing a letter, or mayhap signing a check, there is the desk at the right with its elegantly shaded portable. The portrait over the mantle is lighted with a fixture with which the most rigid engineer could find no fault.

In one of his novels Thackeray leads the reader in the course of his description to the door of the heroine's boudoir, but at this point modestly retreats, declining to intrude even his curious pen into this sanctuary of privacy. Our photographer has had less scruples and we are permitted to peep into "my lady's chamber" (Fig. 3). Surely this must be the room of an illuminating engineer! See how the torch is the theme running through all the decorations and furniture, even to the corner posts of the bed! The ancient candle in its reality also finds a place side by side with the modern electric lamp; and its imitation, in the form of a miniature incandescent, furnishes the general illumination of the room.

In Fig. 4 we stand in the vestibule of the villa of Mr. Herman Oelrichs. While we can all admire the majestic beauty of the classical architecture, there are those of us who would doubtless feel more at home amid surroundings that suggest more of the family fireside and less of the heathen temple of worship. With all that modern science and art can accomplish by the unlimited expenditure of wealth, it seems that when it comes to lighting it cannot get beyond the simple candle, the primitive light-source of our ancestors before even the dawn of modern civilization. The metal work of the standards on either hand is exquisitely wrought, and all to support a manifest imitation of one of the crudest of light-sources which any of us may go to the corner grocery and purchase at a penny a piece.

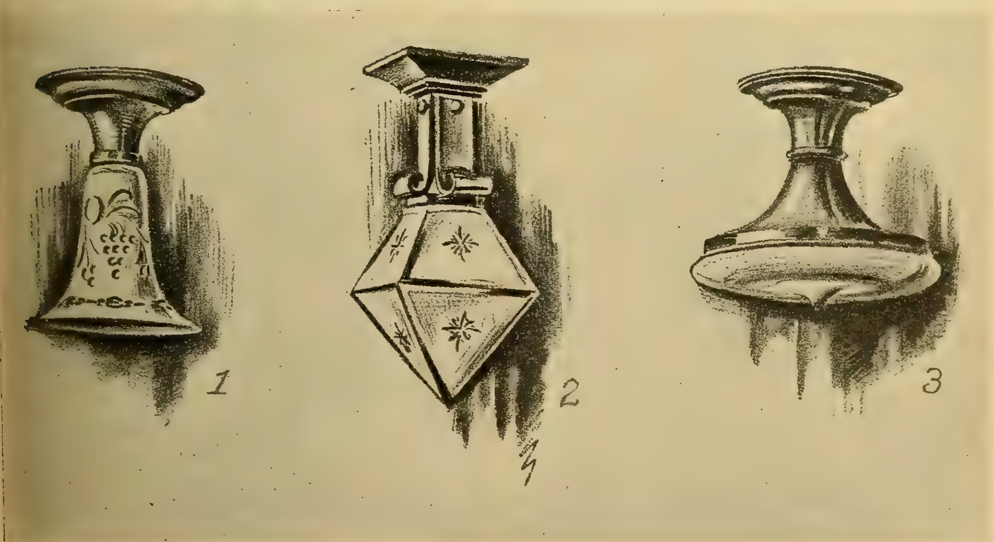
In the hall just beyond, the electric light, though concealed, is used in a more legitimate manner, both on the standards flanking the doorway and in the fixture on the ceiling.

Fig. 5 shows the music room in the same villa. The lighting here is by chandeliers which are in themselves fine specimens of the artistic motives which originated and glorified the period of the Louises of France, and are doubtless of French design and manufacture. As the decoration and the furnishing of the room is strictly in the line of copy, it would be perhaps illogical to criticise the fixtures on account of their imitative motive. We can surely admit that the beautiful conceptions of the truly artistic minds of this period have been freely absorbed and judiciously expressed by our modern copyists; the room is beautiful for the same reason that a faithful copy of Raphael's Madonna or the Hermes of Praxiteles is beautiful.

Fixtures and Accessories

A Study of Some Recent Fixture Designs

We have often called attention to the tendency to copy the early designs of fixtures, particularly those of French origin, and lamented the fact that so little effort was being made in America to create something that should express in the true spirit of art the radical improvements in light-sources that have been made in the last half century. America alone of the progressive nations of the earth has so far failed to reveal herself in the design of lighting fixtures. Generally speaking, whatever we can point out as good in this division of the general field of applied art will be found to owe its merit to artistic motives which originated centuries ago. An installation of modern German fixtures is as distinctly Teutonic and national, and moreover characteristic of the present period, as is the German physiognomy and language. A glance at the single interior of the Berlin Ice Palace, shown in our last issue, is an example which impressively illustrates this statement. In Russia, Scandinavia and Italy we would find the same distinctiveness. It is perhaps less marked in England, which is a more cosmopolitan country, and still less in France, which, like Spain, though in a less degree, is living on the memory of its past glories in the domain of decorative art. But this particular lament is only one of the "voices crying in the wilderness." Literary critics have been long and eagerly awaiting the advent of the truly American novel or poem, and amateurs of architecture have bewailed the failure of American architects



FIGS. 1, 2, 3.

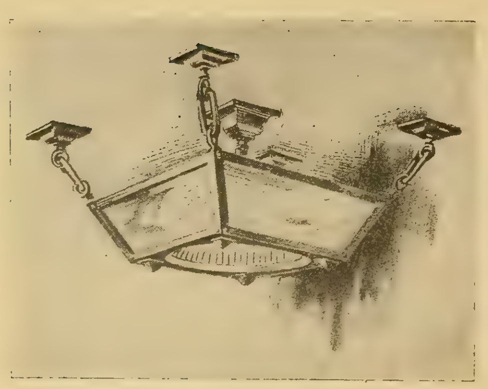


FIG. 2.

to create a type of structure which is characteristically and expressively national.

A number of sketches of fixtures have recently come into our hands which, though perhaps not fulfilling the requirements of possessing national characteristics, are nevertheless worthy of study as showing a distinct and successful effort toward originality. In all the designs there is a sincere treatment of the light-source used, whether gas or electric; they are neither adaptations, imitations, nor distortions of fixtures originally intended for the use of primitive lights.

Let us begin with the simplest type of fixture, namely, that intended to support a single electric lamp as near the ceiling as possible. Fig. 1 shows three different solutions of this problem. In No. 1 the artistic effect is due almost entirely to the harmony of line between the ceiling canopy and the globe. Although the construction is almost in its simplest form mechanically, the artistic motive is well defined. No. 2 departs somewhat from the simplicity and conventionality of No. 1, but still conforms closely enough to the mechanical necessities of the construction to prevent any appearance of superfluous decoration or straining after an effect. It exhibits a particularly successful use of the straight line in producing a pleasing result, the only curve being the scroll covering the globe holder. No. 3 is not strictly original in the design of the metal work, but shows what may be done by considering the globe as a part of the fixture rather than an accessory. Replace the distinctive shape of the globe here used with a plain hemisphere and the whole fixture would become about as conventionally plain and homely as could well be conceived. While the inner construction is not shown, there is room for a suitable reflector above the glass bowl, which would give it an efficiency as a lighting unit that the most critical illuminating engineer could not criticise.

Fig. 2 is a more elaborate design and evidently intended to use a light-source of considerably greater total flux. The advantages of not only the latest and most efficient form of electric lamp are here utilized, but likewise the distinctive property of the prismatic reflector, of transmitting a portion of the light which it does not reflect. While the sketch does not show color, it is evident that the glass in the outer framework is of some of the richly colored patterns now available; or it might easily be set with a leaded design. The light transmitted by the reflector would be ample to illuminate those panes so as to show their beauty of color. Thus, if fitted with a tungsten lamp, the

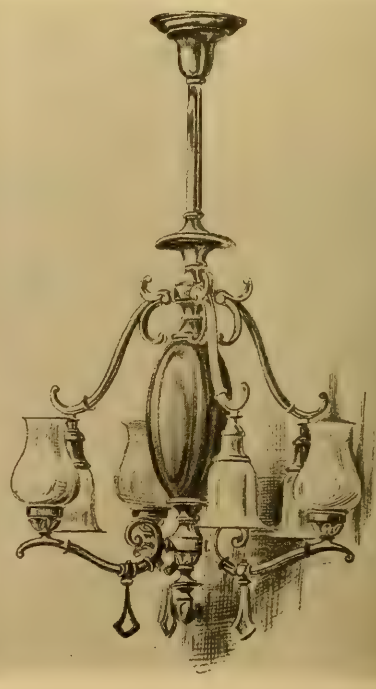


FIG. 3.

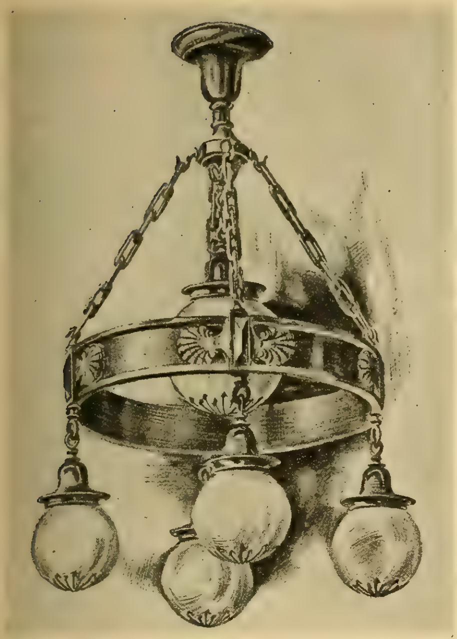


FIG. 4.

fixture would be strictly in accordance with illuminating engineering principles, as well as having a distinct artistic merit, and is thus an example of the principle which we have contended for, that decorative art should be subsidiary to the utilitarian purpose of a fixture.

Fig. 3 is interesting as a combination fixture, in which the characteristics of the two light-sources are plainly distinguished. The lower arms support the gas burners in their necessary upright position, while the upper arms hold the electric lamps in a pendant position, which would be essential for the use of the tungsten lamp. This difference in position of gas and electric lamps on a chandelier is, of course, old in itself; the point here is that by separating the origin of the two sets of supports the distinction between the two light-sources is more clearly portrayed. The handling of the lines and proportions has been done with a high degree of artistic skill, resulting in a general harmony which is at once satisfying to the eye. The distinction between the two light-sources by the difference in the curvature of the globes is a further evidence of the conscientious manner in which the conception of the fixture has been carried out.

Fig. 4 presents a single feature of such incongruity as to be surprising, considering the excellence of the general conception. The use of a metal band to spread the four supporting chains of the outer lamps is hardly new, but is a construction which plainly declares the character of the electric light, and is a very satisfactory motive. The single globe within this band, however, in the position shown, is anomalous; it is hidden from view to a large extent and its light consequently intercepted by the surrounding metal. If used at all, this central globe should have

FIG 5.

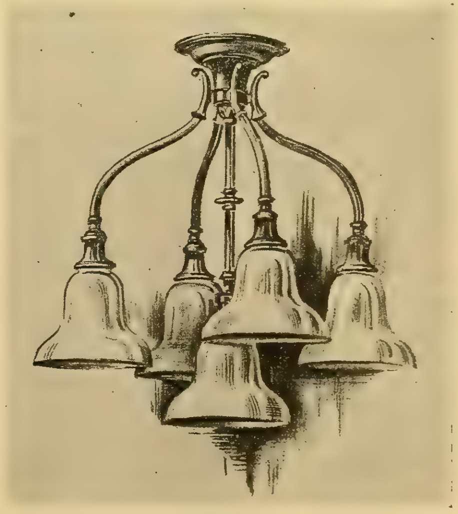


FIG. 6.

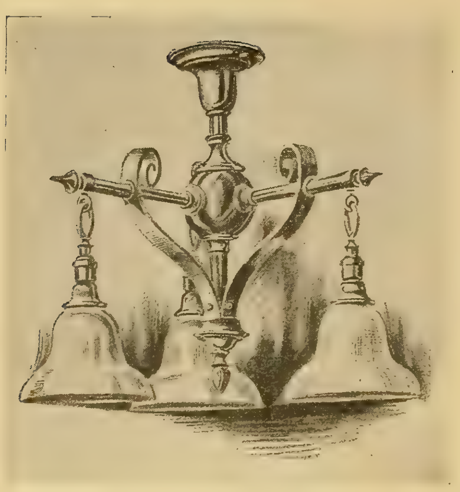


FIG. 7.

been dropped below the level of the outer globes.

Fig. 5 is worthy of study as an example of the pleasing effect which can be produced with a few curved lines, but it makes one shudder to think of the possibilities for incongruous effects producible by substituting other globes for those shown.

Fig. 6 is an interesting illustration of the infallible tendency of the mind to unconsciously consider natural laws. The globes in this case, springing, as it were, directly from the supporting arms, suggest a flower upon its stem, but a flower naturally stands upright instead of hanging pendant. The fixture, though graceful, gives a vague impression of being wilted and drooping. Turn the page upside down and see how the design at once assumes a feeling of vigor and strength; the plant is then growing in its natural form.

Fig. 7 shows the same shade hanging in a pendant position, but there is no sense of incongruity here; it is no longer the corolla of a flower, but an inanimate bell hung by a link from a well braced support; everything is natural and in order, and consequently pleasing to the eye. The criticism applied to Fig. 6 might seem applicable to Fig. 7. A closer inspection, however, will show that the globes used, though flower-like in form, do not spring directly from the arms, but are attached to and suspended from them by a distinct joint where the holder is attached.

Fig. 8 is interesting chiefly as expressing a very simple manner of holding four electric lamps at suitable distances from each other and from the ceiling so as to draw their current supply from the central outlet. While it is evident that the lamps so supported could not possibly be anything but electric, the fact would be still more evident if a cord support were used in place of the chain. Unless very intricate and expensive construction is used the lamps must be wired with flexible cord woven through the links of the chain, and while this does not show in the sketch, it is impossible to conceal it in the actual fixture. We have previously called attention to the fact that flexible cord construction is a legitimate use from the artistic standpoint. Such use is common in England, but has made practically no headway as yet in this country.

As a whole, the designs show a conscious conformity to the frequently quoted dictum of Emerson, that "we ascribe beauty to that which has no superfluous parts which exactly fulfills its purpose."

FIG. 8.

Theory and Technology

The Effect of Light of Different Colors on Visual Acuity

(*Concluded.*)

By J. S. Dow.

The result of his efforts to utilize visual acuity as a basis of photometric balance the author must confess to have been discouraging. It appeared that there were two distinct criteria affecting one's judgment of "balance." It was found that there was a distinct difference in sharpness in the case of different colors. But this sharpness seemed to be a purely optical effect connected with the accommodation of the eye and apparently unaffected by the illumination within wide limits. It was, in fact, possible to secure greater *sharpness* of the pattern with light of a certain color, in spite of an obviously lower order of illumination.

On the other hand, another possible criterion of balance was the *contrast* between the pattern and its background, *i. e.*, the extent to which the pattern "stood out"; if this be the condition by which judgments are based the instrument would be used as what might be termed a "relief photometer." In this case it was found that, when linear detail was used, the method led to results practically equivalent to those obtained by the "equality of brightness" method. When patterns consisting of alternate light and dark patches were used, however, the matter seems to become more complicated, possibly because the eye no longer judges the brightness of the mass as a whole, but selects the individual bright patches. For instance, to the writer it appeared that, when the chessboard pattern (Fig. 2a) was superimposed over two patches of, say, red and green of equal apparent brightness, the small red squares invariably appeared brighter than the small green ones, though somewhat less sharp. This is what would be naturally expected when it is recalled that the effect of using smaller illuminated surfaces is usually to favor the red end of the spectrum owing to the lack of sensibility of the central portion of the retina to the region from green onwards.

In any case it would seem that the effect of superimposing detail of this kind over the illuminated surface is to introduce complications, and the writer's experience is that it tends to cause bewilderment rather than to assist judgment in attempting to balance the photometer; he personally would prefer to judge by "equality of brightness" pure and simple as far as convenience is concerned.

A number of experiments were also carried out with graduated patterns of the type shown in Figs. 2b and 2d with the object of comparing the visual acuity obtainable with light of different colors. As a result it seemed that even for more or less pure green or red light there was not a very marked difference in visual acuity to be observed in the case of near vision. It appeared, however, that there was a distinctly better result obtainable

by using the green end of the spectrum, as is illustrated by Fig. 3.*

The ordinates in Fig. 3 correspond with the scale of acuteness in Fig. 2b.

It is interesting to observe that the really sharp bend in the curve occurs about 0.5 candle-meters. When allowance is made for the use of an artificial pupil-orifice (which, of course, diminishes the apparent illumination) this result agrees very well, under the circumstances, with the value of 0.2 candle-meters, which other experiments of the writer have suggested to be about the order of illumination at which "cone-vision" is believed to be replaced by "rod-vision" when the field of view subtends a relatively small angle at the eye.

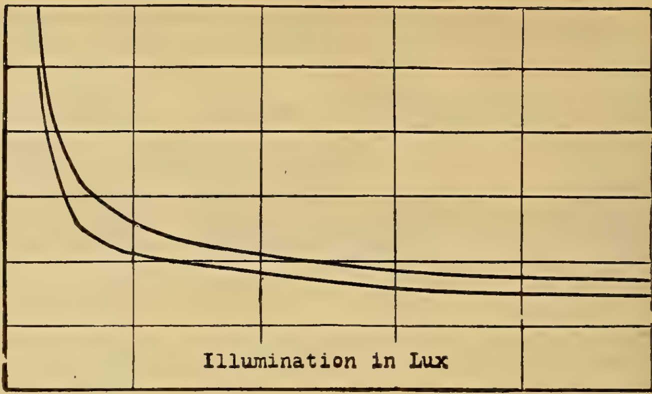


FIG. 3.—VISUAL ACUITY FOR RED AND GREEN LIGHT NEAR VISION. DISTANCE OF EYE, 30 CENTIMETERS.

These experiments have been repeated under many different sets of conditions, and there seems no doubt that, in the case of the author, the red end of the spectrum is not so good as the blue, and as far as the sharpness of fine detail is concerned, *in the case of near vision.* This result is therefore qualitatively in agreement with that reported by Professor Ashe (*loc cit.*). It is also in agreement with that of MM. Laporte and Broca to the extent that such difference in visual acuity, as seems to exist, even for red and green light, is not very marked, and it seems reasonable to suppose that for most ordinary illuminants the difference is, as these authorities find, still less appreciable.

On the other hand, it is interesting to recall that other observers seem to have come to an opposite conclusion. Thus L. Weber (*E. T. Z.*, 1884, p. 166) attempted to assist the judgment of the relative brightness of two different colors by superimposing over the illuminated surfaces a series of concentric circles of various thicknesses somewhat similar to those shown in Fig. 2b. He seems to have found that, if such a pattern were superimposed over two surfaces of apparently the same brightness, the circles on the *red* ground appeared more distinct than those on the *green* ground. He therefore concluded that the most refrangible rays from green onward contributed but little to the detail-revealing power of illuminants, though adding considerably to their power of creating brightness, and he also cited the well-known previous work of Macé de Lépinay in support of this view. Yet it is curious to observe that the authors of the recently issued report to the Conseil d'Hygiène de la Seine (*Rev. des Eclairages,* March 15th) assert the exact contrary.

A possible explanation of this discrepancy that occurs to the author is that, in utilizing the series of concentric circles, Weber introduced the retinal effect previously referred to as characteristic of the "chess-board" variety of detail. The writer himself, when utilizing the concentric circles in Fig. 2b, certainly received the impression that *the black circles on* the red ground "stood out" more; in other words, the red circles appeared

* The question may be raised as to the validity of the figures for intensity of illumination, based as they are on the comparison of heterochromatic sources. It should be mentioned that by an illumination of "1 lux" is meant that the colored surface studied appears to the eye as bright as a similar surface illuminated by white light with this intensity. The actual determination of the brightness of the colored *sources,* which must present difficulties, is uncalled for. The intensity of the brightness of the surface illuminated by the colored light was obtained by actual comparison with white light; the figures given are, however, naturally approximate.

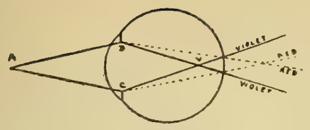


FIG. 4.—WANT OF ACHROMATISM OF EYE.

brighter than the corresponding green ones. Nevertheless the green circles seemed to him the *sharper*.

Hitherto the remarks on visual acuity have referred mainly to close vision, and are therefore applicable to the conditions characteristic of reading and writing. In spite of the use of an artificial pupil-aperture it was found that care was needed to avoid the consequence of obtaining occasional abnormally acute readings owing to the eye making a special effort, apparently due to an unusually severe effort of accommodation. Shortsighted people presumably fail to read a book at a certain distance, because they are unable to focus the letters sharply, and details therefore appear blurred. In the same way it may be suggested that the normal eye does not, as a rule, attain *quite* the sharpest image possible; when called upon for a sudden effort, however, it may accommodate more than usual and thus secure rather sharper images and slightly improved visual acuity. On this supposition the sharpness of the image is largely a matter of accommodation.

There would seem to be a reason why a sharper image should be obtained by green light, in the case of near vision. This rests upon the want of achromatism of the eye, a matter to which the writer has drawn attention elsewhere (ILLUMINATING ENGINEER, New York, March, 1907). The result of this want of achromatism is shown in Fig. 4, which is taken from Tscherning's physiological optics.

Let A be a luminous point which sends the cone of light A, B, C, into the eye. After refraction the violet rays are separated out and brought into focus at V, while the red rays are brought to a focus on the other side of the normal position of the retina. Since sunlight and most artificial illuminants contain chiefly yellow light the retina of the eye commonly adjusts itself to yellow light and assumes a position midway between these points.

When the eye is brought very close to a small luminous white object it becomes easier to accommodate for violet than for red light, and we usually see the white object surrounded by a red fringe. But when the eye is removed to a distance of, say, ten feet from the object the state of things is reversed. It is difficult, however, to see the violet-blue fringe produced in this way because of its low luminosity.

This effect is very clearly shown by several well known experiments, some of which have been described by Shelford Bidwell ("Curiosities of Light and Vision"). Note, for instance, what happens when we observe a naked glow-lamp filament through cobalt glass—a glass which allows both blue and red rays to

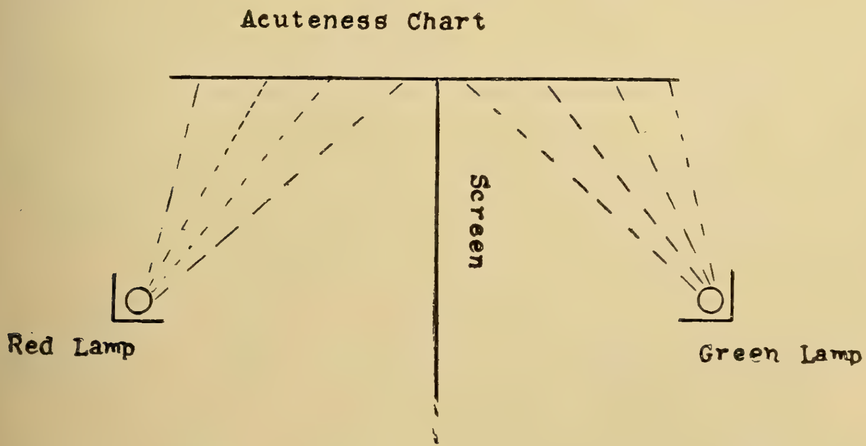


FIG. 5.—ARRANGEMENTS FOR TESTING VISUAL ACUITY FOR DISTANT VISION.

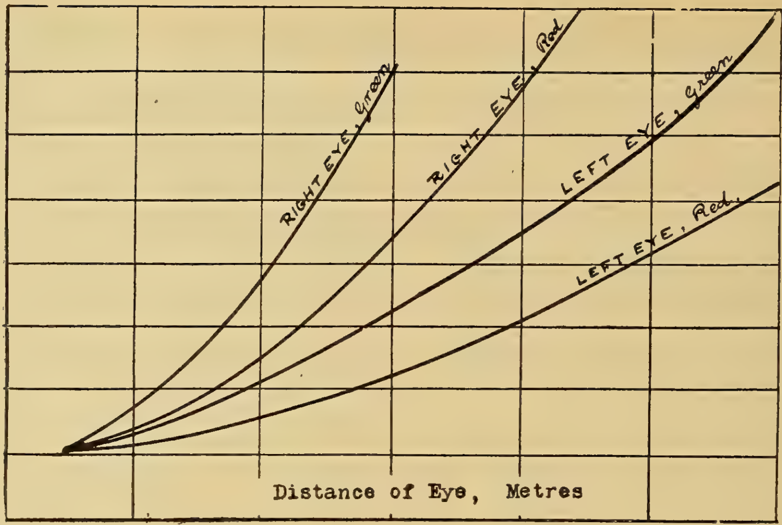


FIG. 6.—VISUAL ACUITY FOR RED AND GREEN LIGHT, DISTANT VISION.

pass, but obstructs the intermediate portion of the spectrum. When the eye is only a few inches away we see a purplish filament with a distinct red fringe.

But when the filament is observed from a distance of a few feet we see a reddish filament surrounded by a distinct ribbon of blue light. As the distance of the observer is still further increased this blue ribbon ultimately becomes a shapeless blue haze, but the filament appears red. In the case of the author this happens at a distance of about twenty to thirty feet, but these results, are, of course, modified by any optical peculiarities that may be present in the observer's eye.

Now this property of the eye may be expected to have an important influence on its power of observing details. The author has also made a series of tests at the Birkbeck Institute with the large chart from which the striped diagram used to obtain the results shown in Fig. 3 was reproduced. This chart was arranged as shown in Fig. 5.

In Fig. 6 are shown the points at which the stripes became indistinguishable as the distance from the eye was increased. It may be mentioned that the illumination due to the red and green lights was equalized anew before each reading. There seems to be a very distinct difference in the acuity between the two colors, almost as great as exists between the author's left eye, which is normal, and his right, which is distinctly shortsighted.

It would seem that most people find themselves distinctly shortsighted for light from the blue and violet end of the spectrum, and in the case of distant vision. For instance, in a demonstration at a meeting of the Physical Society of London in 1908, a black-and-white pattern was illuminated by two patches of red and blue-violet light, produced by placing some specially designed gelatines in the beam of a lantern. The brightness of the red was intentionally reduced to but a fraction of that of the blue-violet patch. Nevertheless those at the back of the room agreed that the detail illuminated by the former was incontestibly the sharper and the easier to distinguish.

Very striking results may be obtained by the use of the mercury vapor lamp, which is particularly serviceable for obtaining pure violet light.

It should, however, be stated that the writer has met with a few people who confessed themselves unable to see any difference at all, and it may therefore be urged that any really authoritative study of this subject must contain investigations on a large number of eyes in order that conclusive results may be estab-

lished; it is hoped, therefore, that the experiments described in this article may lead others to examine the matter more fully.

To sum up, therefore, it would seem that the blue-green end of the spectrum is somewhat advantageous for very close work, but not so good as red light for the illumination of objects or patterns to be distinguished at a distance.

Possibly, indeed, it might be found advantageous to illuminate distant objects—clocks and so forth—with red light, which would also serve the purpose of distinguishing them from surrounding objects and tend to attract attention.

It is obvious, however, that, if an eye is permanently shortsighted for light of a particular kind and is unable to bring it to a focus under certain conditions, no amount of such light, however great, could enable it to see detail so illuminated satisfactorily.

It may be suggested that the considerations urged in what has gone before would lead us to avoid utilizing tests of visual acuity for the purpose served by those of a photometrical nature. When we consider that it is apparently possible for detail upon a surface illuminated weakly by light of a certain kind to appear more distinct than if illuminated with far greater intensity by light of some other variety, we must admit that visual acuity is an unsatisfactory method of testing the illuminating power of sources.

(THE END.)

Some Discussion of a Valuable Paper

J. S. CODMAN.

One of the most valuable papers which was presented at the last convention of the Illuminating Engineering Society was one entitled, "Some Experiments on Reflection from Ceiling, Walls and Floor," by Messrs. Lansingh and Rolph. This can be found in the transactions of the Illuminating Engineering Society, Vol. III., No. 7, page 584. It has seemed to the writer that the real value of this paper would be better brought out if the tables on pages 601 and 602, giving the final results, were rearranged, and if also certain deduced figures were added. The writer has done this for the tables on page 602 for his own convenience, and has thought that others also might be interested. The revised table is given below.

Full details of the tests made by Messrs. Langsingh and Rolph can, of course, be found in the paper. Most of the essential data explanatory of the figures is, however, given in the table below, but to this should be added the following, which is quoted from the paper:

"The room selected was 24 ft. 3 in. long, 11 ft. 6 in. wide and 10 ft. 1 in. high. It was not quite rectangular in shape, one end sloping so that the maximum length was 25 ft. 9 in. and the minimum was 22 ft. The walls were lined with dark green burlap. The floor was nearly covered by dark green rugs and the uncovered part was stained a dark cherry red. Three doors in the wall were stained a dark cherry red. There were no windows in the room. For the experiments with light ceiling, walls or floor, use was made of a lining of light cream colored wrapping paper. The lighting units employed were 40 watt, 115 volt tungsten lamps, and the reflectors were of the prismatic equal prism type. The reflectors were built to give what is termed the bowl distribution, and were of a new design recently introduced. The light units in each case were placed close to the ceiling, the socket being approximately flush."

In addition it should be stated that the three lamps were placed on the long axis of the room. They were not, however, placed evenly, for some unexplained reason. The finish of the ceiling when "dark" is not stated in the paper.

The accompanying table differs from the original one in the following particulars: In the first place it is rearranged in order to show the progressive increase in illumination, as the different surfaces are made light, and also to make more easy the comparison of the installations with and without reflectors. In addition has been added a column showing the per cent. increase due to the use of reflectors, and two columns showing the lumens ef-

fective in per cent. of the lumens generated by the lamps, while the last two columns are given in "lumens per watt" instead of in "watts per lumen." The columns in the original table showing the "effective angle" have been dropped, as in the opinion of the writer this term is misleading, and consequently undesirable.

The first thing to note in regard to the above table is the close agreement between the calculated illumination, which is the theoretical illumination with all surfaces absolutely non-reflecting, and the "all dark" measured illumination, especially when reflectors were used. This demonstrates the low reflecting power of the green walls and dark ceiling.

We should next note the steadily increasing illumination as surfaces were one after the other given a light color. Making the floor of light color had little effect, but light walls or light ceiling had a very marked effect. With bare lamps, a light ceiling had decidedly more effect than light walls, due to the lamps being close to the ceiling. With reflectors, however, the difference was not nearly so great.

The absolute amount of increase of illumination due to the light surfaces is also of interest. It will be seen that with "all light surfaces," as compared with "all dark surfaces," the illumination was with bare lamps, 4.1 times as great, and with reflectors 2.5 times as great.

The increase of illumination due to the use of reflectors runs from 16 per cent. with "all light surfaces," to 90 per cent. with "all dark surfaces." Probably 25 to 30 per cent. represents an average figure.

Finally, a very interesting set of figures are those for the lumens effective in per cent. of the lumens generated, varying from 14 per cent. with bare lamps and dark surfaces to 67 per cent. with reflectors and light surfaces. We see by these last figures how easily light can be wasted when installations are not made with due regard to the principles of illuminating engineering.

*Room 24′ 3″ long, 11′ 6″ wide, 10′ 1″ high; 3 40-watt Tungsten lamps close to ceiling. Lumens generated, 933; test plane 2½ feet above floor.

	Mean foot candles.		Per cent. increase due to reflectors.	Lumens effective.		Lumens effective in per cent. of lumens generated.		Lumens effective per watt.	
	Bare lamps.	Reflectors.		Bare lamps.	Reflectors.	Bare lamps.	Reflectors.	Bare lamps.	Reflectors.
Calculated illumination	0.41	0.89	117	113	245	12	26	0.94	2.04
Measured all dark surfaces	0.48	0.91	90	132	250	14	27	1.10	2.08
Light floor	0.50	0.90	80	137	248	15	27	1.15	2.06
Light walls	0.85	1.15	35	234	316	25	34	1.95	2.64
Light ceiling	0.94	1.17	24	258	322	28	35	2.15	2.68
Light floor and walls	0.92	1.23	34	253	338	27	36	2.11	2.82
Light floor and ceiling	0.99	1.20	21	272	330	29	35	2.26	2.76
Light walls and ceiling	1.57	1.74	10	432	479	46	51	3.60	4.00
All light surfaces	1.96	2.27	16	540	625	58	67	4.50	5.20

* Data obtained from paper by Lansingh & Ralph. Transactions of Illuminating Engineering Society, Vol. III.

The National Electrical Contractors' Association Convention

The annual convention of the National Electrical Contractors' Association was held in Toledo on July 21st, 22d and 23d. Both open and closed sessions were held the first two days, and the last day was given over to an outing on the lake, which was preceded by a banquet held Thursday evening.

Even the Senate of this free republic finds it necessary to conduct part of its deliberations behind closed doors, and it is certainly not to be counted against commercial organizations that they find a similar practice necessary. Publicity is a good thing for those things which ought to be made public; but neither society nor government could exist if every one made public all he knew.

The purpose of the Electrical Contractors' Association, like that of its brother societies, is to promote the welfare of all its members in particular and electrical contractors in general. Its main purpose unequivocally tends toward industrial and social betterment in its particular line of industries, and the character of its members is a guarantee that the ways and means which it may follow in the accomplishment of this purpose are safe, sane and just.

The cornerstone of this organization, as of others of its class, is the principle "Live and let live." That the practical results are beneficent is plainly shown by the fact that those branches of industry which have the most active and extensive associations are not only most prosperous, but exhibit the greatest degree of legitimate co-operation and mutual good fellowship. The more intricate and scientific an industry becomes the greater is the opportunity for unintentional slovenly work and premeditated fraud. Conscientiousness is a virtue with the preacher or the teacher, but with the practical scientist or engineer it is absolutely vital. The false precept may or may not influence you for evil; but the unsoldered joint hidden with tape may burn your house over your head. Against the hidden possibilities of conscienceless engineering only the power of public opinion and condemnation can prevail; and it is the strengthening of just this sentiment that is one of the chief values of such associations as that of the Electrical Contractors. It is not to be expected that any organization can suppress all of the evils which spring up in its particular branch of industry. So long as there are victorious armies there will be camp followers ready to rob the dead and dying; and so long as one corporation or individual forges ahead of its competitors there will be found those ready to lie in ambush and snipe off such stragglers as they may catch unawares. Eternal vigilance is the price of even a reasonable degree of freedom.

To come back to the more scientific discussion of the subject: The convention, from the observer's point of view, made the distinct impression of enthusiastic and serious work on the part of all the members present. Had not some old philosopher got it noised abroad that "comparisons are odious," we might draw some parallels between this convention and others that have taken place during the season. As it is, we must be content with

the simple positive statement that in the hearty and earnest support manifested by every attending member, the high grade of good fellowship, which never degenerated into mere boisterousness, and the serious efforts made to handle the many difficult problems confronting the business represented it might well furnish a model to any similar organization.

We have frequently pointed out the remarkable opportunities which the rise of illuminating engineering has thrown in the path of the electrical contractor; that the contractors are arising to the occasion is shown by the fact that both last year and this year they have had papers or addresses on the subject presented at their conventions. This year the editor of The Illuminating Engineer was invited to address them on the subject. Just what was said in this address

"My modest pen
Would liefer not repeat."

That they were awake to the importance of the subject, however, was manifest by the close attention given to the remarks that were made.

With the sincerity of honest conviction, we say: "More power to the National Electrical Contractors' Association."

The Study of Color as a Branch of Illuminating Engineering

The importance of an intimate knowledge of both the physical and æsthetic theories of color on the part of illuminating engineers is becoming increasingly apparent. This is due to the rapid development in two distinct lines of science—namely, the chemistry of dyes and pigments and the production of light from varying substances and under conditions producing light rays of widely different color composition.

We still speak of "royal purple," since this color was in ancient times obtained from dyes that were so rare and expensive that none but royalty and the enormously wealthy could afford their use. Curiously enough, the first dye produced by synthetic chemistry, and which was the forerunner of the almost infinite variety of the so-called aniline dyes which have completely revolutionized the art of dyeing, was a color very nearly akin to the royal purple, known as Hoffman's violet. Not only has the royal purple been produced at a mere trifle of cost, but also a range of colors and hues, both in fabrics and on solids, that for purity and brilliancy of tone and delicacy of tint rival the solar spectrum and the colors of the polariscope.

Any present day theatrical spectacle is a practical exhibition of the marvels of color chemistry. Even the colored lights which are projected with such superlatively beautiful effects are produced by gelatin screens colored with these same anilines. Let any one who wishes to see the triumphs of modern color chemistry witness a performance at the New York Hippodrome.

Aniline colors, however, often possess qualities which are by no means expressed in their effect of natural light. They are highly "selective" in their reflective powers, a property to which their surpassing purity of tone is doubtless due. The phenomena of color are commonly explained by analogy to the much grosser physical phenomena of sound; and just as sound is never made up of a single tone, but is always a blending of a number of tones of different pitch, so color as ordinarily observed is a combination of various color tones. As the ear is unable to resolve a sound into its component tones from the mere effect of hearing, so the eye is incompetent to resolve a color into its constituent elements by ordinary vision. Thus two pieces of cloth which in daylight may appear of exactly the same color—for instance, red—to the unaided eye, may in fact have reflected a light of quite different absolute color composition. This difference in quality will become apparent when the two objects are viewed under a light having a different color composition from daylight. For example, two reds which were in daylight of apparently the same color might contain quite different admixtures of yellow and blue. If these were viewed under a light that was distinctly yellow it would bring out the full value of the yellow admixture in the one and would suppress the blue admixture in the other, with the result of producing quite different total ef-

fects. It may therefore readily happen that colors which are accurately matched by daylight will be found wholly out of harmony when viewed by artificial light.

The case is related of a carpet mill which changed its dyer. As the new dyer did not have the exact formulæ of his predecessor to work by, he was obliged to match the various colors by his own methods, which was not a difficult task. The various patterns which were being put out were continued; but it was not long before complaints began to come in, accompanied with rolls, pieces, and made-up carpets, with the statement that they utterly failed to match the former carpets of the same pattern. An investigation showed that, while the match was perfect by daylight, under artificial light it was a total failure.

The moral of this plainly is that those whose business is handling color must study at least one phase of illuminating engineering, and that illuminating engineers must carefully study the subject of color.

Another still more remarkable instance is reported of a yarn that showed a pink color under the light of the mercury vapor lamp. This of course was due to fluorescence, as it is well known that the light of the mercury vapor lamp contains no red rays; fluorescence, moreover, being a rather common property of the anilines.

The experience of the carpet manufacturer points to wide possibilities for similar experiences; for example, the wall decorations of a room might be made to harmonize with the tapestries under flame gas light, and if incandescent gas were later substituted might show a very decided color discord.

Those who have held the opinion that illuminating engineering is only "an elaboration of the obvious" will do well to ponder the subject of color among the numerous other problems with which the illuminating engineer has to deal.

The Third Annual Convention of the Illuminating Engineering Society

The summer has been wisely chosen by the majority of national organizations as the time for holding their annual conventions. This is a part of the general tendency to make these events attractive and recreational, as well as mentally and financially profitable. The choice of time and place that will facilitate carrying out this idea is also a noteworthy and praiseworthy custom. In the illuminating field the convention season this year, as for the two years past, began with the National Electric Light Association Convention in June, and will close with the Illuminating Engineering Society Convention in the autumn.

The latter society has established a precedent of selecting a time and place for its annual gathering which places it as an event among a more general program of public festivities. The first convention was held in Boston during its "Old Home Week," and the second one during a week of similar festivities in Philadelphia, celebrating the founding of the city. This year the Hudson-Fulton Celebration, which is to take place in New York City, from Saturday, September 25th, to Saturday, October 9, inclusive, furnishes a specially fitting time and place for the convention, in accordance with the custom that has been established.

While heretofore the convention program has occupied two days, it is proposed this year to extend it for another day, and to have but a single session on each of the three days. The dates are Monday, Tuesday and Wednesday, the 25th, 26th and 27th of September. The sessions will be held in the main auditorium of the United Engineering Societies building 25 West Thirty-ninth street.

An entertainment program is being arranged, which will consist of social events on two of the evenings, with special sightseeing facilities for the lady guests during the day. While the program of papers is not yet complete, it can be authoritatively stated that a particularly valuable list of papers will be presented, most of which will contain the results of investigations not hitherto published.

The exhibition feature, which was introduced for the first time last year in the small, but attractive, educational exhibit, will be greatly extended this year. The Exhibition Committee has been fortunate in securing the use of the premises at 5 West Thirty-ninth street, about midway between Fifth avenue and the Engineering Societies Building. These premises

consist of a private residence, which was especially fitted up and occupied for a number of years by one of the leading fixture manufacturers of the city for public showrooms, and is therefore admirably suited for the present purpose. There will be an educational and historical exhibition under the direction of the society as before, and in addition commercial exhibits by the various manufacturers of lighting appliances.

The magnitude of the Hudson-Fulton celebration, which will unquestionably be the most elaborate event of the kind ever produced in this country, will naturally draw visitors from every section of the country and favorable transportation rates may be expected. Fortunately, the dates chosen for the convention are those on which special and somewhat local features of the general celebration will take place, so that there will be the minimum of counterattractions to those who are interested in the sessions of the convention.

The General Convention Committee is as follows:

E. L. Elliott, Chairman.
Walter A. Addicks.
Henry L. Doherty.
Dr. A. H. Elliott.
Dudley Farrand.
Dr. Alexander C. Humphreys.
J. H. Jourdan.
John W. Lieb, Jr.
William Cullen Morris.

EX-OFFICIO:

W. H. Gartley, President of the Society.
A. J. Marshall. } Managers, New York Section.
C. A. Littlefield. } Managers, New York Section.
J. J. Humphreys. } Managers, New York Section.
Arthur Williams, Vice-President, New York Section.
G. C. Keech, Vice-President, Chicago Section.
J. S. Codman, Vice-President, New England Section.
Charles O. Bond, Vice-President, Philadelphia Section.

The personnel of this committee is not only a guarantee of the success of the convention, but noteworthy as representing the comprehensive and widespread interest which is being manifested in the welfare of the society.

As the hotels will be crowded far beyond their normal capacities, those intending to come should make their reservations at the earliest possible date. Communications addressed to the Hotel Committee, Illuminating Engineering Society, 25 West Thirty-ninth Street, will receive prompt and careful attention.

The International Acetylene Association Convention

This convention will be held at the Hotel Knickerbocker, New York City, August 9, 10 and 11. It is an impressive evidence of the magnitude of the lighting industry that a single branch of it can reach the proportions represented by the acetylene industry to-day and still remain so comparatively inconspicuous. There are unquestionably millions of people in this country to-day who do not know the meaning of the word acetylene, much less understand its production and uses. Of those to whom the word is not an entire stranger there is probably a majority who think of it only as applied to some sort of a gas, the characteristic of which is to "blow up." These statements are by no means made in disparagement of the industry itself nor those interested in its promotion; it is only another illustration of the enormous extent of our country and its industries, and the time and effort necessary to familiarize the people with a new scientific discovery—even one of such wide application and usefulness as acetylene.

It is not to be expected that all of the fantastic and revolutionary effects at first predicted from the discovery of a cheap method of producing acetylene should be realized. Those who hailed it as a means by which the householder was to be given a weapon wherewith to slay the octopus known as the gas or electric company have found that they were only dreaming. Gas from the old time works still flows through the same old pipes, as well as the new ones; and the electric conduits from the central station continue to ramify in every direction like the roots from the green bay tree; but for all this the business of producing calcium carbide and of providing the ways and means for its utilization have gone on apace. The millions of householders beyond the reach of

the gas company and the central station have an easily available means of securing a light quite equal in convenience, quality and cost, all things being considered, to their neighbors in the city or town. Its use in lighting harbors and waterways has greatly facilitated travel, while its use in the powerful headlight is a factor of very considerable importance in that revolutionary method of land travel, the automobile.

Like every other light-source, acetylene has its peculiar advantages and disadvantages; and there is a sufficiently large field in which its advantages are conspicuously in excess of those of any other light-source to give it a prominent position in the general field. Those interested in its promotion have wisely chosen the lines of least resistance, and have made its merit known where it would be most appreciated. The American people above all things dislike to trouble themselves. The electric light at a much higher cost has made enormous progress over other illuminants on the simple ground of being more convenient. For this reason it is idle to expect any appreciable adoption of individual acetylene plants in locations where a public supply of electricity or gas is available; but in mere point of numbers such places are considerably in the minority; hence the wide field for the introduction of acetylene. The general tendency in every direction is toward cheapening the production of light and this will doubtless take place in the case of calcium carbide as a source.

While the acetylene light offers less opportunities for illuminating engineering in the restricted sense of the term, it unquestionably offers an excellent field for those inclined toward the practical and commercial side of light production.

Notes and Comments

Syracuse, N. Y., Working for a Carnival of Light

WILL HAVE SPECIAL ILLUMINATION DURING ITS CARNIVAL WEEK.

A week of carnival is one of the events of the year in Syracuse. This year the efforts to make the event interesting and enjoyable include an increase in the spectacular lighting of the city. Additional arches will be put up over portions of the principal streets, and signs and other features by private sources will be increased. An elaborate display of pyrotechnics will form one of the principal features. From this it is only a step to a complete exhibition of what can be accomplished by the numerous light-sources now in commercial use.

Fargo, N. D., Has Seen a Great Light and Wants It

IS TO INSTALL A TUNGSTEN CLUSTER SYSTEM SIMILAR TO THAT USED IN ST. PAUL AND MINNEAPOLIS.

It is a poor town that does not have its Waldorf Hotel, and Fargo is not a poor town. Its Hotel Waldorf, furthermore, is evidently the center of gravity of the city, for it is proposed to install a system of modern street lighting along the curbs about its site, which will be an example to the rest of the city. Posts similar to those used in St. Paul and a number of other cities bearing one 100 watt and four 80 watt tungsten lamps will be used in the new installation. The *Forum* makes the very safe prophecy that "there is not the least doubt that within a very short time the majority of the business district will be illuminated in this manner."

All Ways to be "White Ways" in Washington

ELECTRICAL ENGINEER ALLEN AND COMMISSIONER McFARLAND WORK TOGETHER FOR A COMPREHENSIVE SYSTEM OF BETTER STREET LIGHTING.

Probably in no city of the United States is such a systematic, careful and comprehensive study of street lighting been made as in the national capital during the past year. Valuable data on the subject, giving the results of some of the work, have been contributed by the Electric Engineer of the District, Mr. Walter C. Allen, through the Illuminating Engineering Society and through our pages. Probably in

no other city of its size in the world does the problem of the obstruction of light by trees form such an important problem in street illumination. Practically the entire city of Washington is one vast park, and its avenues and street parkways are lined with magnificent trees. Mr. Allen suggests two general methods of obviating the difficulty: First, by placing the lamp standards in the middle of the street in the wider avenues in the business section; and, second, by rearranging the sidewalks and replacing the lamps in the residence districts. A detailed report with recommendations for a thorough revision of the present street lighting system, with a request for the necessary appropriation for carrying it out, will be made by the Commissioner to the next Congress.

New York City to Have Another "Great White Way"

Fifth Avenue Merchants in a Compact to Make the Business Section of the Avenue the Whitest Ever.

Business is now practically in complete possession of aristocratic Fifth avenue from its beginning at Washington Square to Forty-seventh street. While the installation of poles supporting two arc lamps with opal globes was considered such brilliant illumination as was befitting a show street in a metropolis when it was installed a number of years ago, it is now gloomy in comparison with the "White Way" section of Broadway. To bring it up to candle power, the present lamps are soon to be replaced with lamps of twice the light-giving power. The Fifth Avenue Association, which has been instrumental in the widening of the avenue, is now looking after the lighting, and among other things is endeavoring to have all the store windows kept illuminated in the evening. This brings out the fact, which may surprise some outsiders, that there should be any darkened windows on such a thoroughfare in the evening; but the shadows of exclusiveness still hover over certain parts of the street, and there are a few stores which still pull down the shutters when they shut up shop at six o'clock, as did their ancestors a hundred years ago. It is only something over a year ago that the old-fashioned horse stage coach was the only public conveyance on the avenue; but even fashion and exclusiveness have had to give way to the march of industrial progress, and it is a foregone conclusion that the business part of the avenue will became as brilliant a spectacle, in its way, as Broadway.

Jumping Off Place Is Where the Street Lights Stop

Des Moines Doesn't Like the Idea of Being Cut in Two by Lightless Streets Along the River.

The situation in Des Moines is not only interesting locally, but points a moral to many other cities. As set forth in the *Tribune:*

East Des Moines cannot afford to allow this lighting project to drop. It is not the river that divides the city, it is bad pavements at the river, and darkness.

The only reason why Fourth street has been the jumping off place on the west side is because the light has stopped there and until now the good pavement.

Lighting Locust street from end to end will not only do more to give the city a city look than any other possible expenditure of money, but it will do more to make both sides of the river part of one city.

With the building of the city hall and the Coliseum and the postoffice and the cleaning up of the river banks, this lighting should go in. It may seem a little extravagant all at once, but the time to do a thing is when the spirit is to do it.

If Des Moines gets Locust street into an avenue of light this year and the other public improvements it will be a city no matter if it never has another booster organization of any sort.

It Beats the Dutch

Taxpayers of Reading, Pa., Want to Be Shown a Thing or Two About Magnetite and Tungsten Lamps Before They Contract for Their Use in Their Streets.

A new contract for street lighting is contemplated by the city of Reading, which involves the use of magnetite arcs and tungsten lamps. That there is some difference of opinion on the proposed change appears from the discussion of the matter in the local press.

In a recent issue of the *Telegram* Dr.

Brobst, president of the Taxpayers' League, has an open letter in which he requests that the lighting company immediately put up a number of the new lamps at certain locations, so that the citizens, as well as the council, can judge of their relative merits. He apparently believes that a demonstration of this sort will show the superiority of these new luminants, for the use of which he is contending. He also gives a long list of cities and towns in which these lamps have already been successfuly used.

Greatest Illumination Ever Produced to Be Shown During the Hudson-Fulton Celebration in New York

ILLUMINATING ENGINEERING SOCIETY CONVENTION WILL BE HELD DURING THIS CELEBRATION.

Even the illuminating engineers on Mars will have an opportunity of studying the possibilities of modern lighting during the coming Hudson-Fulton Celebration in this city, which will be held during the last week in September and the first week in October. Some of the most experienced and competent illuminating engineers in the line of spectacular lighting have already been working on the scheme for some months, and the results will far surpass anything that has ever before been attempted in the world.

As nearly as can be estimated at present there will be between 1,000,000 and 1,500,000 incandescent electric lamps; 700,000 carbon arcs; 300 flame arcs; one battery of four searchlights of 100,000 candle power each; one battery of twelve searchlights aggregating 1,700,000 candle power; all burning for six hours each night during the celebration, making a total of over 26,000,000 candle power in addition to the regular lighting, both public and private, of the city. Any illuminating engineer, and especially if he be a member of the Society, who fails to come to the convention and witness this spectacle of modern lighting will miss an opportunity of a lifetime.

Odds and Ends

A number of smaller towns in South Dakota are putting in electric lighting systems operated with gas engines. The equipment of some of these " Central Stations " runs as low as $2000, and the most expensive mentioned costs $4000. It takes the West to get on to improvements.

Ithaca, N. Y., wants the Public Service Commission to give it cheaper gas. While they are about it, they also ask that the electric company be overhauled. The present price of gas is $1.60. The people want the price reduced to $1.

The city of New Bedford, Mass., has a new building for the Registry of Deeds. Bids were asked for fixtures according to certain specifications. The result showed a range of price from $3786 to $7706. Will some of our friends in the fixture business explain this discrepancy, and incidentally tell us where the highest and lowest bidders in this contest expected to get off?

The Commercial Club of Topeka, Kansas, proposes to begin a better lighting system for the city with the dome of the capitol, and from this work downward and outward into the streets. Their plan is to outline this dome with incandescents and arc lamps. The scheme will be carried out as soon as formalities can be complied with.

The Aldermanic Lamp Committee of Buffalo has reported in favor of putting up twenty-five more electric lamps, and seven extensions of the gas lamp district, provided the funds are available. At this rate Buffalo will be a well lighted city—some time next century.

Chicago ought to have a very warm feeling toward the Commonwealth Edison Company. When the city was " strapped " last January and could not meet its payrolls the Edison Company " advanced " $100,000 on account of its tax. It has recently handed over the balance of its tax, amounting to about $400,000. " A friend in need is a friend indeed."

Correspondence

FROM OUR SPECIAL CORRESPONDENT

Electric Illumination Topics in Great Britain

BY JAMES A. SEAGER.

The British voter has recently been suffering from a bad attack of engineering scare. Not content with acute neurosis on the subject of airships and Dreadnoughts, he has been filled with pessimistic prophecy concerning the disastrous effects which the metallic filament lamp will have upon the receipts of the electric light authority. As a large proportion of English electricity supply systems are municipally owned, this has touched him deeply as an intelligent citizen. It is therefore pleasing to note the symptoms of returning equilibrium in the presidential address delivered at the annual convention of the Incorporated Municipal Electrical Association at Manchester. The speaker was Mr. S. L. Pearce, the well-known City Electrical Engineer of Manchester, who should be eminently qualified to judge, inasmuch as his supply system depends very largely on lighting load.

He admits—as indeed is apparent to every engineer interested in illumination problems—that there are few undertakings which during the past year have not experienced serious reductions in output and diminished revenue in consequence of the adoption of the new lamps. But he inclines to the view that the worst of the check has been experienced, that the prospects of the electric lighting business have been altogether improved by the advent of the metallic filament lamp, and that nothing should be done to arrest an increase in new connections just when they are most urgently required.

In addition to this decision, which, coming as it does from one of our foremost electricity supply engineers, must necessarily carry an immense amount of conviction, Mr. Pearce gave two other important contributions to the subject of practical illuminating engineering. The first is that there will be, or should be, a demand for a metallic filament lamp in which some of the efficiency is sacrificed to stability. It is worth suggesting that this is worthy of more than a passing thought by lamp makers. The public is quite sufficiently satisfied with the advance made by the intrinsic merits of the new over the old type of lamp to render a war of fractional efficiencies unnecessary. It is said that a metallic filament lamp cannot be blackened, but its character can, if it dies young. The second point which Mr. Pearce made was the utmost importance of having the public educated up to the advantages offered by the high-efficiency (or metallic filament) lamps, particularly those householders on the line of route of existing mains, whose increment of load can thus be obtained at a very trifling capital expenditure. This is, of course, the exact point at which the illuminating engineer, with his expert knowledge, may join hands with his colleague in the heavier branches of electricity supply with mutual advantage.

The very interesting subject of the "international candle," by the adoption of which the unit of candle power as understood in the United States, Great Britain and France will be coinordinated, was discussed in a paper recently read by Mr. C. C. Paterson before the Physical Society of London. The text of the official memorandum issued with the sanction of the Bureau of Standards, Washington; the National Physical Laboratory, London, and the Laboratoire Centrale, Paris, will be already familiar to the readers of THE ILLUMINATING ENGINEER, but reference

may be permitted to the close agreement between the comparisons of the units of the various countries as made by the direct comparisons of the flame standards and by the evaluation of electric substandards in the different testing laboratories interested. This points to the very great use which suitable electric lamps have as secondary standards for the measurement of illumination, inasmuch as they are portable, constant and convenient. The fact that they are unaffected by draughts, moisture, number of investigators in the photometric room, and other accidental causes is, as Dr. Fleming pointed out in the discussion on the paper, a very valuable feature in favor of their adoption. This argument has received an almost dramatic illustration in the fact that carefully seasoned electric lamps, after having been carefully tested against the American standards, were sent thousands of miles to the European testing establishments as the link of unchangeable value enabling the standards, situated so far apart, to be tested one against the other.

The formation of the Illuminating Engineering Society in Great Britain is, thanks chiefly to the unremitting work of Mr. Leon Gaster, proceeding in a satisfactory manner. At the meeting of the society on May 27, as reported in the *Illuminating Engineer* of London, the constitution and by-laws were approved, subject to such legal alterations or additions as might be found expedient. The existing committee, which includes Mr. J. Darch, Mr. J. S. Dow, Mr. Justus Eck, Mr. H. T. Harrison, Mr. C. Hastings, Mr. J. W. Ife and Dr. H. Parsons, were reappointed and given power to add to their number, while Mr. Leon Gaster was reappointed honorable secretary to the society. The offices of the society are located at 32 Victoria street, London, S. W., and the membership, whether in the ordinary, honorary or corresponding class, is extended to either sex and any nationality, the minimum limit of age being twenty-one years. The constitution of the society is modeled to a considerable extent upon its fraternal organization in America, and the constitution of the Council is interesting as evidencing the well-balanced nature which their decisions are likely to have. Three representatives of each of the following phases of industry or profession interested in illuminating engineering are to be chosen: Gas lighting; electric lighting; systems of lighting such as acetylene, petrol-air, etc.; manufacturers of illuminating apparatus; electricity and gas supply, including the consumer's standpoint; the architectural profession, surveyors, etc.; oculists and ophthalmists; general physical science and photometry; illumination of buildings and fire insurance.

We have for some months been waiting with almost painful expectancy for the advent of the low candle-power high-voltage metal filament lamp. From time to time rumors have been rife regarding the immediate advent of such a lamp, but hitherto it has never materialized. From the offices of the *Electrical Review* of London, however, comes the interesting announcement that they have actually burning in their offices a 16-candle-power metal filament lamp for 210 volts. This has been supplied by the Stearn Electric Lamp Company, Ltd., and though the new lamp is not yet actually on the market, it is lightening the labor of the *Review* editors. The lamp is similar in shape to the ordinary carbon filament lamp and contains nine loops of a metallic filament which has been produced by an improved process permitting of extreme fineness of the thread. The consumption of the lamp is stated to be 24 watts, which gives a rate of 1.5 watts per (British) candle power. This is slightly under the average for the metallic filament lamps, but is nevertheless a notable advance on the carbon lamp consumption, allowing a saving of 60 per cent. of energy to be made. The effect of the introduction of this lamp, if commercially successful, will be to induce the subdivision of light sources into smaller units, giving a more uniform illumination, and will in many cases do away with the objectionable overillumination of small rooms which the advent of high-power metal filament lamps has produced, with the result of ophthalmic strain on the persons who use such high intensities.

One of the most interesting exhibits at the *conversazione* of the Royal Society on June 24 was a selection of the parabolic

reflectors made by electric deposition according to patents of Mr. Sherard Cowper-Coles. Some of these were coated with gold, others with silver protected by palladium, and in some cases gold and silver radial bands were employed. These reflectors are all metal and are therefore much more useful for electric searchlight and motor car work than the older forms in which glass is employed. By deposition upon the convex side of a glass mould (which is afterward withdrawn) of first a chemical film and secondly an electrically augmented deposit, the errors produced in spinning, stamping or casting metal reflectors are overcome, the result being a truly parallel reflected ray. The object of using a gold-surface reflector is to obtain an increased penetration of rays in foggy weather, the light emitted more closely resembling that of an oil lamp in color value, while being of the intensity obtained from the electric arc. The yellow rays are particularly advantageous for lighthouse work. The banding of gold and silver is employed to give any required blend of yellow and white light. As the focal length of the metal reflectors can be made very short owing to the fact that there is no fear of cracking or blistering by heat, the silver is coated thinly with palladium, which, although reflecting only 64 per cent. of the light obtained from a silver surface, protects the silver from the tarnishing effects of being close to the arc light. Reflectors coated in this way have stood a temperature of 740 degrees F., obtained by proximity to an arc light, without tarnishing, and they will also resist the action of salt water.

In view of the outcry which has been raised against the use of flame arc lamps for interiors, it is interesting to note that at the recent Royal Horse Show held in London no less than 102 Excello arc lamps were employed to illuminate the building, with very fine results. Sixty of these were of the twelve-ampere type, fitted with self-contained compensators and provided with deposit-free covers, the remainder being of the 12-ampere Excello type with ordinary cover. All the lamps were burnt four in series on 220 volts at a frequency of 50 cycles.

From Our Baltimore Correspondent

The progress in the production and use of artificial light is nowhere better exemplified than in our modern summer amusement resorts. Baltimore can boast of a number of these enterprises, where the illumination sends its welcome afar to those who seek to escape the burdens and heat of the day in the many interesting and amusing features with which these places abound. It was not many years ago that a huge pine tree hung with colored lamps formed an attraction to which people flocked from all parts of the city to see. This same resort, now known as Riverview, by reason of its beautiful location on the river bank, welcomes its enormous throng of patrons by a finely illuminated arch which has been erected at the entrance, a photograph of which is shown in Fig. 1. The view of the resort as seen from one of the bay steamers is entrancing. The myriad incandescent lamps forming many beautiful and intricate patterns on the various buildings are doubled in beauty by reflection in the water.

Another of Baltimore's amusement parks is called Electric Park, a fitting name in view of the lavish use of electric lamps which are used in its decoration. The gateway is particularly fine, being guarded on either side by towers, tapering from a fifteen foot circle at the bottom to a point at the top, and outlined on all sides with lamps. Within is a dancing pavilion of hexagonal shape, the roof of which is studded with incandescents, while huge spheres suspended from the ceiling, each containing 100 lamps, add to the general brilliancy of illumination. Viewed from the distance, the location of these parks can be readily seen from the light in the sky above.

A notable improvement in lighting was recently made by the Park Commissioners at Druid Hill. Heretofore the old-fashioned open arc lamps were used about the bandstand, which were both unsightly in appearance and unsatisfactory in results. These have recently been replaced with tungsten lamps and prismatic reflectors suspended from the roof of the stand, while about the stand a new type of enclosed arc lamps has been installed on high ornamental iron pedestals. The

ENTRANCE, RIVERVIEW PARK, BALTIMORE.

combined result is a highly satisfactory illumination and a distinctly decorative effect.

The ordinance recently passed for the inspection of electric light meters has been approved by the Mayor and has become effective. Superintendent McCuen, under whose charge the inspectors will work, is now arranging details, and as soon as inspectors are appointed the work will begin in earnest. There are already a number of requests for inspection by users, and the inspection is sure to work to the mutual benefit of the consumer and lighting company.

SYDNEY C. BLUMENTHAL.

Commercial Engineering of Illumination

A Fertile Field

Those who make their living by tilling the soil naturally prefer to locate where the soil is richest, and those who cultivate the buying public for the purpose of harvesting profits from a crop of advertising judiciously sown likewise desire that their seed should not fall in stony places. The parable of the sower can be applied with literal exactness to the advertiser.

There is probably no more fertile ground in which to plant the seeds of publicity than the field of lighting. Every human being is, by force of circumstances, a user of light; and the majority are misusers. He who sells illuminants, or the means of using them, is therefore a purveyor to the entire human family. He sells not only what they ought to have, but what they must have, in some sort. Consider the elements of variety and interest in the general subject of light, and compare them with other fields of trade and commerce; see what endless subjects for profitable discourse are presented; how easily the subject could be made attractive. Take a concrete case; for example, breakfast foods. Suppose you had a million dollars to spend advertising a new brand of "cereal"; what would you say about it? What *could* you say about it that was either new or interesting—or true? To what base uses of doggerel and bastard art might not your soaring genius be reduced! And yet fortunes have been made, and are continually being made, by the cultivation of this seemingly barren and exhausted field. Or, suppose you had to invoke the muses to inspire your song in praise of chewing gum, what an idiotic drool could you evolve that would fit the case? And yet the ruminating tendencies of the vulgar half of America have put millions into the coffers of the chicle dispensers—a rich harvest from the seeds of advertising.

But those who live on the richest soil are not always the best husbandmen; and those whose business offers the most enticing field for advertising do not always reap the harvest that its full cultivation would produce.

The lighting field is far from being tilled up to the last limit of intense cultivation. While everybody uses some light, not every one by any means uses as much light as he could to advantage. The central stations and the gas companies have the choicest advertising field in existence to-day. The subject, though old, is full of living interest and is continually kept so by the progress of science. It can no more become trite and commonplace than can science itself. There is not only always something to talk about, but something about which interesting facts can be told. The subject is always dignified, without being austere; always important, as affecting the most precious function of the human machine; always interesting, from its many-sided connections with the affairs of life; always fresh and new from the perennial growth of science.

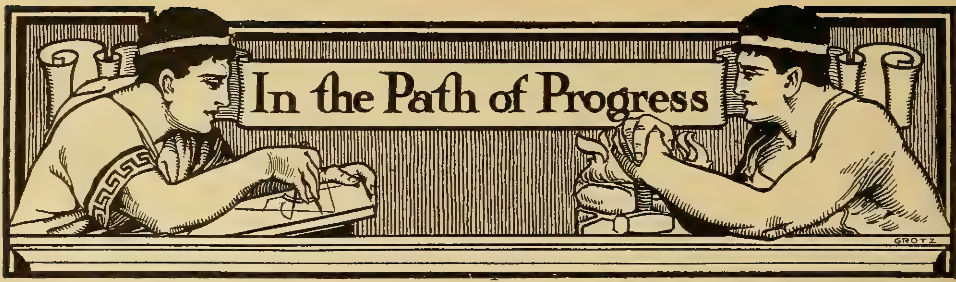
Not only does light form an inexhaustible subject for advertising discourse, but can be made to proclaim its own uses and

importance. You may shout your wares from the house tops and your words will not be heard across the street; yet do but light up so much as a candle and its rays will proclaim its existence and usefulness to the limits of the horizon. "At night all cats are gray," said Franklin, and when nature and the works of man are thus reduced to a shapeless leaden mass light speaks its universal language through the infinitude of space. Who cannot instantly read the meaning of the well lighted street? Not only he who runs, but he who rides, whether in trolley car, automobile, or carriage, can read its message of enterprise and thrift and welcome.

The lighting company that does not use in full measure the advertising facilities afforded by its local press and by the circulation of special literature pertaining to the subject is not sowing as well as it might. The merchant who does not invite the public to come and see for themselves through the medium of attractive illumination is not taking full advantage of his opportunities. And the city or town which does not light its streets, its parks and its public buildings to a degree commensurate with the science and art of modern illumination is a standing advertisement that its wheels of progress are crumbling with rust and wabbling in the ruts of custom.

If for no other reason than to lift the veil of mystery and secrecy which the average consumer insists upon throwing over a lighting company, a judicious but constant use should be made of local advertising mediums. The amount of popular ignorance upon the mere use of light after it has been produced is something astonishing; and what is to be expected as to general knowledge upon the ways and medium of producing and distributing the luminant, of which the public sees almost nothing? To the average householder and taxpayer, the electric lighting company is a corporation producing a mysterious force called electricity, which it distributes and sells in a way that is wrapped in still deeper mystery, and whose dearest wish and purpose is to charge the customer in some way for more than he receives. Although longer familiarity with the gas company has given it some measure of public contempt, there is still a deep rooted notion that it is largely engaged in pumping air into the gas mains, and by some inscrutable means causing meters to turn around, against all the laws of nature, when no gas is passing through them. The generation and distribution of both gas and electricity are subjects which have much of interest for the person of average intelligence and education. There is nothing of interest lacking in the material; it only needs the right telling.

THE ONLY BUSINESS IT DOES NOT PAY TO ADVERTISE.



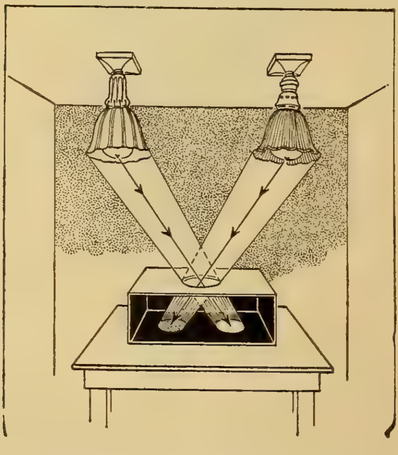
A New Demonstration Photometer

The following ingenious device is described in a communication from the Central Electric Company, Chicago:

The average photometric measurement method is not well adapted for use by a layman who does not care to know, as a rule, the intensity of a source of light or an illumination in terms of a standard, but simply desires a visual comparison which will indicate which source gives the brighter light without caring to know just how much brighter one source is than the other.

A simple practical method of comparing the intensity of illumination has been worked out in the fixture studios of the Central Electric Company, Chicago, Ill., and a short description of the method may be of interest to the central station solicitors and others called upon to demonstrate lighting effects to the ordinary consumer.

The method is simply one of comparison, the two sources to be compared being located approximately as shown in the illustration, in which the intensity of the light reflected from one source is being compared with the intensity of the light reflected from another source.



A SIMPLE DEMONSTRATION PHOTOMETER.

The usual practice is to mount two sockets and shadeholders approximately four feet apart on the ceiling of the fixture or display room and equip each holder with the desired shade, care being taken to have the sockets connected to the same source of supply in order to operate the lamps under the proper voltage conditions. Care should also be taken to select lamps having approximately the same watt consumption in order to secure a fair comparison.

The measuring or comparing device is placed on a table and consists of a rectangular box provided with a round hole in the top, this hole being so located that a ray of light emitting from either of the lamps will throw a light spot on the horizontal shelf, on which is placed a piece of white paper. As will be seen from the illustration one side of the box is left open, so that an observer can readily see the interior.

With two sources of light located as shown in the diagram two light spots are thrown on the white paper, and it is a very easy matter to select the brightest spot. It should be remembered that the light rays cross; that is, the light from the left lamp being thrown at the right hand side of the measuring device and the light from the right being thrown at the left hand side of the measuring box when facing the same.

Recent Improvements in the Nernst Lamp

The announcement in the advertising matter of the Nernst Lamp Company of a new lamp which lights instantaneously really gives little suggestion of the extent of the improvement involved. To most people the fact that it required a few seconds for the Nernst lamp to become luminous was a matter of trifling importance, at least as compared with the cost of maintenance of the lamp. The method

of producing the light instantaneously is ingenious and highly interesting from the purely scientific standpoint. In the lamps heretofore put out, both in Europe and in this country, the glowers have been started by a small heater coil of fine platinum wire wound on a small porcelain rod placed underneath the glower. These heater coils were expensive to make, both in point of labor and material, and, as they of necessity burned out in the course of time, involved a certain charge for maintenance.

The new heater is nothing less than a filament of carborundum bent into small convolutions and placed in the usual position. This heater is produced by treating an ordinary carbon filament of the desired form in an atmosphere containing gaseous silicon, after the ordinary method of flashing. This results in the conversion of the carbon into a silicide, or carborundum. Such a filament will withstand a temperature of mild incandescence in the open air for a long period of time without deterioration. As the resistance is even much higher than a plain carbon filament, only a short length need be used. When the current is first switched on these heaters become incandescent and give out a mild illumination at the same time that they heat the glowers. When the glower becomes hot enough to take current the starting filament is cut out by the usual mechanism.

At the same time with this improvement other minor improvements in construction are announced, which make it possible for the average user to re-set glowers when they are broken from use.

The march of progress in electric lighting seems to maintain a curiously even pace all along the line.

A New 200-250 Volt Tungsten Lamp

The General Electric Company has extended its production of tungsten lamps into voltages from 200-250. This gives to the users of higher voltages the opportunity for the adoption of the economical high efficiency lamps for multiple service. The new tungsten has the usual tungsten efficiency of $1\frac{1}{4}$ w. p. c.

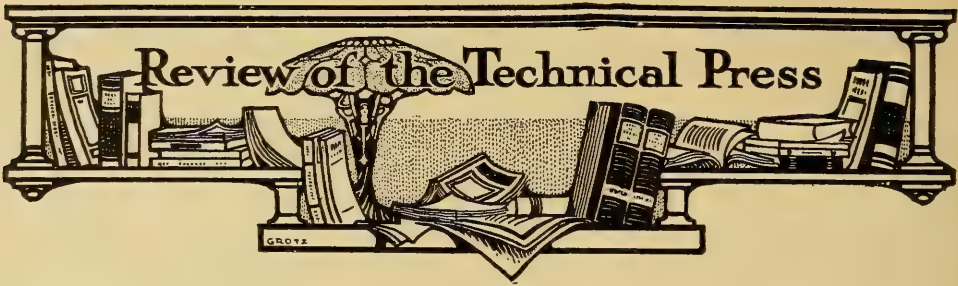
Thorough and ample tests of the new 200-250 volt tungstens show exceptionally good results, the average life and performance of these lamps being fully up to that of the standard multiple lamps. They are a decided triumph for lamp manufacture, and will prove very popular with all who require 200-250 volt lamps. The lamps are supplied in the following sizes: 45 watts, 70 watts, 110 watts, 180 watts.

Car Lighting With Opalux

The introduction of tungsten lamps has given a decided impetus to electric car lighting, and with this has come a demand for new types of reflectors. One of the most serious practical drawbacks to efficient car lighting with reflectors is the inevitable collection of dust or dirt. With the ordinary type of reflector it is absolutely essential that the lamps be removed, and the reflectors subjected to a thorough washing in order to remove the dust or dirt. This necessitates constant attention and is frequently costly in that, aside from the actual expense of time and wages of the caretakers, an additional and very heavy expense is introduced due to the breakage of reflectors and tungsten lamps incident to the necessary handling.

Experiments have recently been tried with "Opalux" reflectors, which by reason of their smooth surface, permitting of easy cleaning, and their soft, opalescent tints, which harmonize well with the usual rich colorings of car decoration, have met with most gratifying success.

DINING CAR LIGHTED WITH "OPALUX" REFLECTORS.



American Items

THE ELECTRICAL SOLICITOR'S HAND BOOK. —Published by the National Electric Light Association, Editorial Committee: Arthur Williams, Otis Allen Kenyon, Norman G. Meade and Adolph Hertz.

This is the hand book, the idea of which originated with Mr. J. Robert Crouse while promoting the Co-operative Electrical Development Association. It is the work of twenty contributors, a number of whom were awarded prizes in a contest held under the auspices of the above association and the National Electric Light Association. It contains sections on Business Getting, Talking Points, Illuminating Engineering, Heating Engineering and Power Engineering.

The section on illuminating engineering contains much valuable matter and is in the main well written. It will, of course, be understood that the avowed purpose of this book is to promote the use of electricity, and its treatment of illuminating engineering may therefore be expected to lean decidedly toward electric lighting. Thus, on the subject of the color of light, it says: "In commercial work where colors have to be compared, as in dry goods stores, etc., a white light must be used. The ordinary incandescent gas lamp, owing to the greenish color of the light it gives, is very little used for the purpose of matching and selecting colored goods." And again, under "Artistic Effects": "Light containing red gives a sensation of warmth and makes people look rosy and soft skinned, while green, like that from a Welsbach burner, gives a sensation of cold and makes faces look ghastly and sickly." This is either an inexcusable repetition of old ideas based upon conditions which have long since ceased to exist or it is a deliberate attempt to put incandescent gas lighting in a false position. In either case the supposed facts stated are untrue and should therefore have no place in a book which professes to treat a subject with scientific accuracy. All good incandescent mantles at the present time, whether made by the Welsbach Company or other reputable manufacturers, give a light which is a nearer approach to average daylight, or standard white light, than any other source except a short carbon arc, the claims for the much vaunted whiteness of the tungsten lamp to the contrary notwithstanding.

A carelessness in the use of terms is shown where the diffusion of light (of the flame arc) is spoken of, where distribution is evidently meant. There is a very wide difference between diffusion and distribution, and there is no excuse for a confusion of meanings.

The entire treatment of the flame arc will certainly be questioned by the manufacturers of this type of lamp. The following is one of the six points which are given for the guidance of the illuminating engineer: "The fumes and ash given out by the lamp, the unsteadiness of the light and the objection of frequent trimming render it unfit for most cases of interior lighting." As to the fumes and ash given out we would like to hear from our flaming arc friends. As to steadiness of light, we can say offhand, what can easily be verified by any observer, that it is at least

the equal of any form of arc lamp in existence.

Under "Filament or Incandescent Lamps" it has the following historical information: "The incandescent carbon filament lamp was invented by Thomas A. Edison." That is a disputed point in history which has practically no bearing upon illuminating engineering. Sir Joseph Swan and Sawyer & Mann are contestants for this honor.

The technical description of the different lamps is of doubtful value in a work of this kind. On the rating of lamps we find this information: "Nowadays the mean spherical candle power has been adopted as a basis of comparison." Since when, and for what comparison? Certainly not for the purpose of commercial rating. Continuing: "The complete measurement of the spherical candle power involves much work with a special apparatus." This is interesting as showing how rapidly the science of photometry has advanced. It is possible to measure the mean spherical candle power of an incandescent lamp with either a Matthews or a globe photometer with practically the same ease that its horizontal intensity can be determined.

In the treatment of the Nernst lamp the color fallacy again turns up, in this statement: "After the arc lamp the Nernst lamp is the best artificial light for showing natural or daylight colors of the material it falls upon." Both casual observation and accurate measurement with the Ives colorimeter show that mantle gas lamps give a light nearer in color to daylight, as before stated. The color of the light from a Nernst glower is distinctly yellow, although in this respect it is at least the equal of any electric light-source except the short carbon arc.

On residence lighting the following information has a decided bearing upon the vexed servant problem, as well as upon pure illuminating engineering. "The lighting of servants' bedrooms is a debatable point, as it encourages reading there and consequent long hour burning. Servants are also apt to learn a little electrical engineering, just sufficient to change the light for high candle lamps from other parts of the house. * * * In some houses the lamps in the servants' bedrooms are so wired that they can be controlled by a switch in the dressing room or a similar place and the consumer can extinguish their lamps when he goes to bed himself." A house in which any of these atrocities is perpetrated should be boycotted for all time by any servant who has sense enough to light a candle. There are apparently two sides to the servant problem.

Under "Factory Lighting" we read: "Where the ceilings are low, inverted arc lamps should be employed, as they light indirectly by reflection, by the light being thrown on the ceiling and thence reflected on the work. This method produces a very soft diffused light, very pleasant to work by." The relative value of indirect lighting for purposes where careful eye work must be done is by no means a generally accepted fact at the present time. On the contrary there are many who consider it decidedly objectionable.

In the treatment of the mercury vapor lamp one of its most valuable characteristics, that is, of bringing out fine details with unequaled sharpness, is entirely omitted.

Here is a point that will interest our gaslight friends on the subject of "Store Lighting": "Electric light more than any other artificial illuminant can be best adapted to meet the requirements of the storekeeper. A point that should be carefully attended to by the central station in advising the laying out of an electric light installation for a store that has previously been using gas is to see and always insist that, for the first three months or so, the storekeeper only gets light which is comparable with his former gas illumination. This will make him satisfied with his bills. Afterward when he sees how much better lighted other stores are and wishes to increase his own lighting, as he is sure to do, he will appreciate the fact that his electric light bills are greater in amount than his former gas bills not because electric energy is an expensive luxury, as some misinformed people erroneously say and think, but because he is using so much more light. If this is not a challenge to the gas interests

to take up illuminating engineering, we should like to know what sort of a hint they need.

The author of this section seems to lack the courage of his convictions. While he recognizes illuminating engineering in the very title of the chapter, he makes a complete surrender when it comes to the laying out of the illumination of large buildings. In the paragraph on this subject we read: "The illumination of a large building is not an easy matter, and requires more experience than that possessed by an architect or wiring contractor, and should, therefore, be put into the hands of a consulting electrical engineer, accustomed to deal with illuminating problems, as it is a very important matter, not only in regard to the cost of electric energy consumed, but in regard to the costs of the installation and the quality and distribution of the light furnished." According to this view of the case, the only work left for the illuminating engineeer, apparently, is to act as a stalking horse to show people how much better electric light is than gas light. It is amazing that any one capable of writing on the subject of illuminating engineering should so stultify himself.

THE MERCURY ARC RECTIFIER SYSTEM AS USED FOR STREET LIGHTING, by W. B. Clayton and James W. Craig; *Illumination,* July.

A brief technical description, with illustrations, of this method of street lighting.

ACETYLENE FOR DECORATIVE CHURCH LIGHTING, by L. G. Suscipj; *Acetylene Journal,* July.

The article describes and illustrates an exceedingly attractive scheme of illumination used in a church at Corneville, France. Particular interest attaches to this church from the fact that its ancient chime of bells is made the basis of the story in the familiar and tuneful opera usually known in this country as the "Chimes of Normandy." The article is a revelation of the possibilities of acetylene light for decorative and spectacular purposes.

OIL LIGHT EXPLOSIONS, by "R."; *American Gas Light Journal,* July 19.

Gives the causes of a number of explosions of oil light systems using storage tanks. The writer states that "the article is written for the purpose of warning persons against buying cheap oil lighting outfits advertised at sacrificed values. There are plenty of very good oil and gas outfits, for sale at your local dealers. Let your own manufacturer install your outfit at his own price. It will pay. The country is flooded with circulars advertising cheap, easy-to-run and perfectly safe outfits. Look out for them, for some of them are dangerous."

AMERICAN GAS LIGHT JOURNAL.

This pioneer journal of the public lighting industry in this country celebrates its fiftieth anniversary by the issuance of a special number under date of July 19. The development of the gas industry during the past half century is set forth by a number of prominent writers, numerous illustrations being used which add greatly to the interest of the subjects treated. These include portraits of those who have had a prominent part in the growth of the industry. The story of the *Journal's* history is also attractively told. As an instructive work of reference on the history of gas in the United States, this copy of the *Journal* should have a place in the library of every one interested in the subject of lighting.

HYGIENE OF THE EYE, by Albert J. Marshall; *Light,* July.

This is Chapter V. of Mr. Marshall's contributions to this journal under the department of Light and Illumination. While the information given is accurate, it is highly technical and quite different from the popular treatment of the subject of illuminating engineering with which the writer started out.

MODERN LIGHT-SOURCES AND INDUSTRIAL LIGHTING, by H. Thurston Owens; *Engineering Magazine,* July.

A brief summary of the properties and peculiarity of the different commercial light-sources now in use.

Color and Visual Acuity, by J. S. Dow; *Electrical World,* July 15.

An exceedingly valuable discussion of this important subject by a writer who has given it special study.

Uniformity in the Photometry of Colored Light-Sources, by F. E. Cady; *Electrical World,* July 22.

After reviewing briefly the difficulties of the photometry of lights of various colors, the author describes a method in which colored screens are used to overcome these difficulties.

Printing and Illumination; *Electrical World,* July 29.

This article is an interesting and valuable discussion of the relation of modern printing to illumination. The question which was brought up by Mr. Marshall some time ago in The Illuminating Engineer as to the value of reversing the customary practice and using white or light letters on a dark background, is discussed somewhat at length. The following conclusions contain many valuable suggestions:

The remedy for existing conditions apparently lies in the reduction of extreme contrasts by the simplest possible means, and especially in the use of matt-surfaced papers and dead black inks for all printing designed for close application. Some of the very worst examples are to be found in text-books in which highly calendared paper is employed to facilitate the use of half-tone cuts. All printers are sinners alike in this matter, and they probably will continue to sin so long as a good and durable matt surface paper remains high in cost. The cry is for cheap books, which implies the use of cheap paper and cheap inks. When the public is willing to pay a small additional price for well-made and durable books of permanent value, reform will be easy.

Foreign Items

Compiled by J. S. Dow.

ILLUMINATION.

The Illuminating Engineering Society Founded in London, 1909 (*The Illuminating Engineer,* Lond., June).

Gives an account of the meeting held on May 25, when the draft constitution of the society was formally ratified. In the same number will be found the complete draft constitution, which is, however, subject to slight legal alterations.

The Executive Committee were also reappointed by the meeting, with power to add to their number, and was to form the first Council of the society.

EDITORIALS.

The Proposed International Unit of Light. Municipal Interest in Illumination. The Lighting of Poor Law Institutions. The Progress of the Illuminating Engineering Society. (*The Illuminating Engineer,* Lond., June).

Retailing Light (*Gas Engineer's Mag.,* June 15).

Maladministration of Public Lighting (*J. G. L.,* June 1).

The above editorials, it will be observed, deal with various aspects of public lighting, and this subject has received much attention in the press. Another kindred matter, relating to street lighting, is:

Street Lighting Tests at Bradford (*Electrician,* June 4; *Elec. Engineer,* June 4, 11; *Elec. Engineering,* June 3, 10, 17).

Bradford has decided upon the adoption of gas for public lighting. The electrical papers point out that such decisions should be based on actual photometric tests and present some curves of illumination for the flame arc lighting proposed.

L'Eclairage des Rues de Paris (*Rev. des Eclairages,* June 15).

This again deals with street lighting. M. Massard presents a report to the

authorities urging that the lights in the streets of Paris should not be extinguished so early in the evening, as this is provocative of disorder and crime. The police are also strongly in favor of good night lighting for the same reason.

The Worship of Light, by Dr. M. Gaster (*Illum, Eng.*, Lond., June).

An instructive and popular article tracing the growth of religious and other beliefs from the original worship of light and the light-giving heavenly bodies.

Uber den Schutz des Auges gegen der ultraviolette Strahlen unserer künstlichen Lichtquellen, by W. Voege (*E. T. Z.*, June 3).

The author returns to the discussion of the effects of ultraviolet rays, justifying his assertions regarding the comparatively innocuous character of the ultraviolet radiation in sunlight by fresh experiments. He also describes some tests on protecting glasses of various kinds which are necessary in observing naked arc lights, etc.

Apparatus for Varying the Illumination of Surfaces According to a Predetermined Law, by T. Guilloz (*Comptes Rendus* 148, pp. 164, Jan. 18, 1909).

The author describes an ingenious device which enables him, using an approximately linear source, to produce a patch of light the intensity of which gradually varies according to any desired law.

British Legislation on the Lighting of Factories (*The Illuminating Engineer*, Lond., June).

An account of some regulations that have been recommended with regard to the need for good lighting in connection with certain dangerous trades. This may be read with interest in connection with the most recent annual report of H. M. Chief Inspector (just issued), which contains a number of references to the same matter. One of the inspectors makes special reference to the fact that they have no statutory legislation on many important points on which to proceed.

PHOTOMETRY.

EDITORIALS.

The Proposed International Unit of Light (*The Illuminating Engineer*, Lond., June).

Candles and Confusion (*Elec. Industries*, May 26).

Note Relative à l'Unification des Unites Lumineuses, by P. Janet (*L'Electricien*, June 5).

Betrifft Internationale Lichteinheit (Note from German Committee of the International Electrotechnical Congress), by G. Dettmar.

Hefnerlampe und Zehnkerziger Pentanlampe, by E. Brodhun (*E. T. Z.*, June 24).

The Proposed International Unit of Light, by C. C. Paterson. (Paper read before the Physical Society, June 11.)

All the above contributions deal with the announcement regarding the common international unit to be adopted in Great Britain, France and the United States. The German authorities recognize the proposed arrangement to the extent of admitting the relations between the units, but wish to make it clear that they prefer to abide by the Hefner lamp for the present. Brodhun, for instance, contrasts the relative merits of the Hefner and the Harcourt pentane lamps, arriving at the conclusion that he prefers the former, though the pentane has certain undoubted advantages as regards color and so forth.

At the conclusion of Patterson's paper a discussion ensued, dealing again mainly with the question of light standards rather than units. Dr. C. V. Drysdale's was one of the most interesting contributions to the discussion; he advocated an incandescent black body standard. It was pointed out, however, by several speakers that the adoption of the units was a matter quite distinct from the merits of different types of standards.

Illumination, Its Distribution and Measurement, by A. P. Trotter (*Illuminating Engineer*, Lond., June).

The present installment of this serial contribution deals with photometric scales and gives some particulars of the "moving mirror method of using a photometer bench, which obviates the necessity of altering the position of either sources of light or photometer.

LICHTSTÄRKE DER BOGENLAMPEN UND DIE BOGENLICHTNORMALIEN, by W. Wissmann (*J. f. G.*, May 29).

A general description of the conventional methods of testing arc lamps and expressing their candle power. Also a summary of the chief qualities of arc lamps and their distribution of light, etc.

ELECTRIC LIGHTING.

RICERCHE SOPRA LE NUOVE LAMPADA ELLETRICHE AD INCANDESCENZA TIPO HOPFELT, by U. Bordoni (*Atti della Assoc. Elettrotechica Italiana*, March-April).

Perhaps the most complete record of the researches on the mercury-carbon glow lamp yet published. The author gives details of life-tests, polar curves of light distribution, etc., of the lamps, and discusses the physical phenomena connected with the nature of the radiation from the lamp and the effects taken place on the surface of the filament. The actual performances of the lamps described in these tests, however, are not very satisfactory.

THE INFLUENCE OF THE METALLIC FILAMENT LAMP, by E. E. Hoadley (*Electrician*, June 25).

THE DEVELOPMENT OF THE TUNGSTEN LAMP (*Electrical Field*, Lond., June).

Two general articles dealing with the tungsten lamp situation.

DIE WANDLUNGEN DER METALLDAMPFLAMPE UND DER HEUTIGE STAND IHRES ENTWICKLUNG, by O. Vogel (*Z. f. B.*, May 20, 30, June 10, 20).

A continuation of the author's study of the application of metallic vapors to electric luminants and the theoretical principles involved.

APPEAL AGAINST REVOCATION OF ARC LAMP PATENTS (*Elec. Engineering*, May 27).

An appeal against the revocation (in Great Britain) of certain important patents dealing with flame arc lamps has been successful, the decision of the Comptroller of Patents as to their value under the new act being reversed.

MODERN GLOW LAMPS AND THEIR PRODUCTION, by K. Sartori (*The Illuminating Engineer*, Lond., June).

A general article dealing with the chief properties of carbon and metallic filament lamps. The author gives a complete diagram illustrating all these qualities, and also the results of some life-tests, etc. In this connection interest attaches to the diagram showing the effect of overrunning upon the useful life in both cases. Some remarks are also made as to the desirability of testing life by a "short" test with an excess of P. D. and on the possible drafting of a specification for metallic filament lamps.

DIE POPULARISIERUNG DER ELEKTRISCHEN BELEUCHTUNG, by E. Schiff (*E. T. Z.*, June 24).

NEW FITTINGS FOR METALLIC FILAMENT LAMPS (*Electricity*, May 21).

NEW PROJECTIONLAMPE (*Z. f. B.*, May 20).

16 C. P. 110 VOLT OSRAM LAMPS (*Elec. Engineering*, June 3).

THE LATEST FORM OF QUARTZ MERCURY VAPOR LAMP (*Elec. Rev.*, June 18).

THE FLAMGOLD DOUBLE CARBON FLAME ARC LAMP (*Elec. Engineering*, June 17).

THE PRESENT PRICES OF METALLIC FILAMENT LAMPS (*Elec. Times*, June 10, 17).

A useful summary of the prices and present details of the various types of metallic filament lamps sold in Great Britain.

GAS, OIL, AND ACETYLENE LIGHTING, ETC.

NOTES ON INCANDESCENT GAS LIGHTING, by Dr. C. R. Böhm (*Illuminating Engineer*, Lond., June).

A continuation of the author's serial

contribution dealing with the most recent patents and processes bearing on the manufacture of artificial silk mantles.

EINIGES ÜBER CEROXIDE, by Bruno (*Z. f. B.*, May 30).

Discusses the reason for the falling off of the intensity of a mantle with life. Some have ascribed this to the presumably more volatile cerium oxide being driven off. The author, however, prefers to believe that this oxide enters into solid solution in the thorium constituent, thereby becoming inactive. The nature of the variation in candle power during life is closely connected with the amount of cerium in the impregnating material.

EDITORIAL.

RELATION BETWEEN ILLUMINATING AND CALORIFIC POWER (*G. W.*, June 12).

ILLUMINATING EFFICIENCIES OF CARBON MONOXIDE AND HYDROGEN, USED IN CONJUNCTION WITH THE INCANDESCENT MANTLE, by C. Foreshaw (*J. G. L.*, June 22).

THE CLASSIFICATION OF TOWN GAS, by T. Holgate (*G. W.*, June 12). . . . .

These three contributions deal with a question of absorbing importance to the gas industry at the present time, namely, the connection between incandescent illuminating power and calorific value. The paper by Foreshaw (read at the annual meeting of the Institute of Gas Engineers, London) is of special importance. The author shows that the illuminating value of these two gases cannot be regarded as proportional to their calorific values alone, but depends on other factors, such as flame-shape, etc. He also describes some experiments on the effect of hollow cones within the mantle in improving the efficiency.

LICHTFEUER UND NEBELSIGNALE, by Klebert (*J. f. G.*, May 29).

The conclusion of an interesting and well-illustrated article describing the optical apparatus of various types used in connection with light houses and beacons.

THE SPECIAL TESTING OF PETROLEUM INTENDED FOR USE WITH INCANDESCENT BURNERS, by C. Charitschkoff (*The Illum. Eng., Lond.*, June).

The author points out that the ordinary qualities of petroleum as studied by the conventional tests (specific gravity, flash-point, etc.) do not serve to indicate its value for incandescent illuminating purposes. On the contrary, a quality of much more importance from this standpoint is its tendency to "coke" when burned, and the author mentions a type of apparatus he has designed for the special testing of this point.

GAS UND PUBLIKUM, by E. Schilling (*J. f. G.*, June 19).

A popular article dealing with the treatment of the consumer. The author lays stress on the importance of seeking to teach the consumer how to use his lights to the best advantage. Gas companies would do well to think out the exact position and nature of the sources necessary in different rooms, so as to give him satisfaction and enable him to get the best possible value for money expended.

ELNIGES AUS DER PRAXIS DER PRESSGASBELEUCHTUNG, by O. Vieweg (*J. f. G.*, June 19).

LES PROGRÈS DE L'ACETYLENE DANS LA RÉPUBLIQUE ARGENTINE (*Rev. des Eclairages*, May 30).

INSTITUTION OF GAS ENGINEERS, ANNUAL MEETING (*J. G. L.*, June 15, June 22.; *G. W.*, June 19).

REPORT OF THE COUNCIL OF THE INSTITUTE OF GAS ENGINEERS (*J. G. L.*, June 1).

SPECIMENS OF GASLIGHTING IN BIRMINGHAM (*J. G. L.*, June 1).

DISTANCE LIGHTING BY SPARK IGNITION (*J. G. L.*, June 15).

THE SOCIÉTÉ TECHNIQUE DU GAZ AND DISTANCE KINDLERS (*G. W.*, June 5).

Contractions used.
Elck. Anz. Elektrotechnischer Anzeiger.
Elck ü Masch. Elektrotechnik und Maschinenbau.
E. T. Z. Elektrotechnischer Zeitschrift.
Illum. Eng. Lond. Illuminating Engineer of London.
G. W. Gas World.
J. G. L. Journal of Gaslighting.
J. f. G. Journal für Gasbeleuchtung und Wasserversorgung.
Z. f. B. Zeitschrift für Beleuchtungswesen.

The
Illuminating Engineer

Vol. IV SEPTEMBER, 1909 No. 7

THE WHITE CITY AND THE LIGHT CITY

The World's Columbian Exposition of 1893 was a revelation as well as a realization. It matters little who was the first to give it the title of the White City. Any one who saw it, sitting in its spotless, stately robes beside the blue waters of the lake, must have involuntarily given it the same title. Nor was it less the White City when its vesture was glorified by the numberless electric lamps, which picked out the tracery of its classical architecture as in " patins of bright gold ": the White City was also the Light City.

Why should this marvelous realization of the " city beautiful " serve merely the purpose of making an American holiday? Must we treat our finest architectural conceptions as the countryman treats his frock coat—as something to be enjoyed only on holidays? Is not that larger home, the city, as worthy of wearing the finest architectural garb as the mere ephemeral exposition?

There are enough of the somber colors in life without giving them to our buildings.

The poor little red brick has humbly served its purpose since the days of the Pharaohs. It bears the same relation to modern architectural terra cotta as the hieroglyphic inscriptions bear to modern literature. We can respect its past without setting it everlastingly before our eyes.

White is the counterpart of light, and is both the emblem and source of activity and optimism. Let us have more white buildings! Let us have " White Cities " in which to carry on the affairs of life!

Let there be MORE *light!*

E. L. Elliott.

Measuring Colors by Numbers

By E. Leavenworth Elliott.

"Do you see anything green in my eye?" This familiar question can now be answered more definitely than by the usual grimace or categorical yes or no. If there really is green there it can be measured and the answer given by a numerical expression. "Any color so long as it's red" may be a sufficiently accurate expression for a Western poet, but it will no longer serve the purpose of the scientist; for "science, the strict measurer," is now able not only to analyze the red and tell what dross of other colors it contains, but can actually measure these with a ruler and tell what their relative numerical quantities are.

Color is what Boston is said to be—a state of mind. It is a psycho-physiological perception induced by the action of ether vibrations on the nerves connecting the retina of the eye with the optic lobes of the brain. If you never before knew what color is you know now; and this will aid you to a due appreciation of the achievements of modern science, which has produced an instrument of such simplicity that by looking into the end of a brass tube and moving three small levers you may read off on the scales provided for the purpose the exact composition of the color under examination as easily as the grocer reads the figures on the scale beam or the carpenter the inch marks on his square.

MR. FREDERICK E. IVES.
Inventor of the Colorimeter.

It is an amiable trait of science that she does not leave things half done, and always holds the balance of good and evil in a state of approximate equilibrium. If she shows a means of destruction, she is sure to turn about and show a means of preventing destruction. The science of chemistry has put at our disposal a range of colors applicable to the every-day affairs and wants of life that were undreamed of even a century ago. The "purple of Cassius" no longer comes from gold, but from the reeking refuse of the gas works. With a penny's worth of Hoffman's violet one can be clothed in purple, if not in fine linen. There is no tint or hue of sunset sky or flower or budding leaf whose counterpart cannot be produced from this same tar barrel, when rightly touched by the chemist's wand. Having thus put into our hands infinite possibilities for producing color, science has now given us a means of analyzing and measuring it.

We seldom stop to consider what an extensive part color plays in the practical as well as the scientific side of modern life. Consider for a moment its use on labels and wrappers of every conceivable article of commerce; of its use in books and periodicals; in tapestries and wall coverings; in fabrics and textiles of every description, and you will soon conclude that it is easier to study the cases in which color is not an essential element. The textile industries alone are second in the value of their product only to the iron and steel industry, which they surpass in the number of employees; and in this industry, without exception, the question of color is always of importance.

"What about black and white goods?"

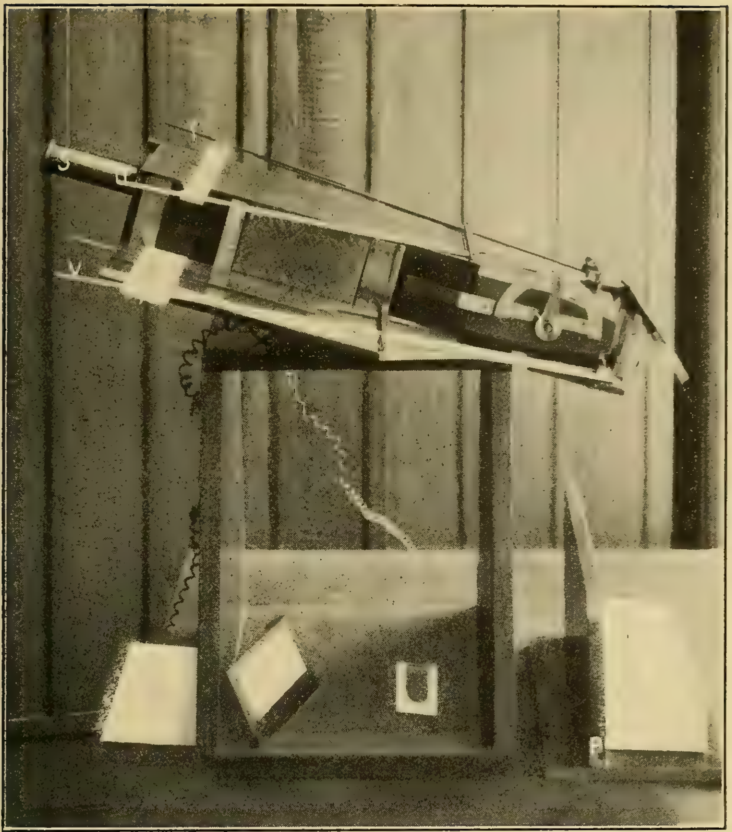


FIG. I.—THE IVES COLORIMETER.

you may ask. Put the question to the manufacturer and he will tell you that there are almost as many colors of black as there are of red, and that white may mean any one of a dozen different shades. There is a manufacturer of white paint that divides the product into thirty different colors of white.

The importance of an accurate and reliable means of measuring and expressing colors in numerical values will be apparent from this brief survey of their commercial importance. It is rather remarkable that such a means should not have been developed before this, but only a few desultory attempts to solve the problem have previously been made, which have resulted in nothing of practical value. But the problem has at last been solved; the instrument for making the measurements has been perfected and is a commercial article to-day. The man who has performed this remarkable and valuable scientific feat is Mr. Frederick E. Ives.

In order to explain the instrument, which is by no means complicated, it will be necessary to state the theory upon which it is based. Let us remark in passing that every scientific instrument, as well as every practical use of science, will be found upon investigation to be based upon that which the true scientist most reveres and the average layman most often despises—namely, pure theory. Strictly speaking, color belongs only to light; it is ascribed to bodies only in a metaphorical sense.*

If you will look at the rainbow, or the band of color produced by sunlight falling through a prism you will see a continuous

* We speak of an object as red, meaning that the light that comes from it is red; just as the musician speaks of the E string of the violin, meaning the string that produces the sound designated by E.

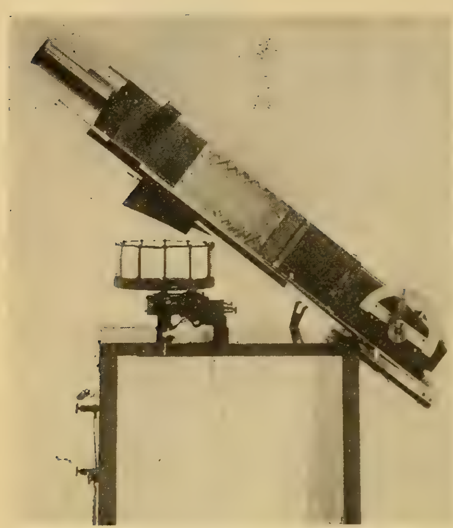


FIG. 2.—COLORIMETER TILTED SHOWING LENSES.

variation from the one side, which you call red, to the other, which you call violet. Between these two extremes are the other "plain colors," yellow and green, with an infinite number of tints. This band of color, known as the solar spectrum, is analogous to the musical scale, or gamut. In stricter analogy, it is like the continuous change in pitch produced by bowing the string of a violin while the finger is run up the fingerboard so as to produce a "slide," rather than the succession of distinct notes of the piano. From this color scale we can, by combining various parts of it, produce different shades, or tints, just as we can produce different chords by the unison of different notes in the musical scale. The musical scale is divided into eight intervals, and with these eight tones, repeated in series if necessary—that is, by octaves—all the musical compositions of the world have been formed.

The older text books on light divided the color scale, or spectrum, into seven primary colors, as follows: Violet, indigo, blue, green, yellow, orange and red. But later investigation has shown that this division was purely arbitrary and fanciful. The true elementary colors must necessarily be those from which we can produce all other possible shades or colors, as well as black and white, which, scientifically speaking, are not colors. It is fairly easy to demonstrate that, by making different mixtures of yellow, red and blue, or, still better, red, violet and bluish-green, it is possible to produce every effect of color distinguishable by the eye, together with black and white. As this cannot be done with any less number of colors, the three mentioned may rightfully be called the primary colors.

If any given shade or tint may be produced by the use of one or more of these primary colors, the converse must be true—namely, that any given shade or color may be resolved into its component parts, consisting of one or more of the primary colors.

To describe any given color, therefore, in exact scientific language, two things are necessary: First, a means of separating the given color into its constituent parts, and, second, of determining the numerical ratios between these constituents. Both of these are accomplished with a high degree of precision and with only the skill acquired by a little practice by Mr. Ives' instrument, which he calls the colorimeter (color measurer). The instrument is equally applicable to luminous and non-luminous bodies.

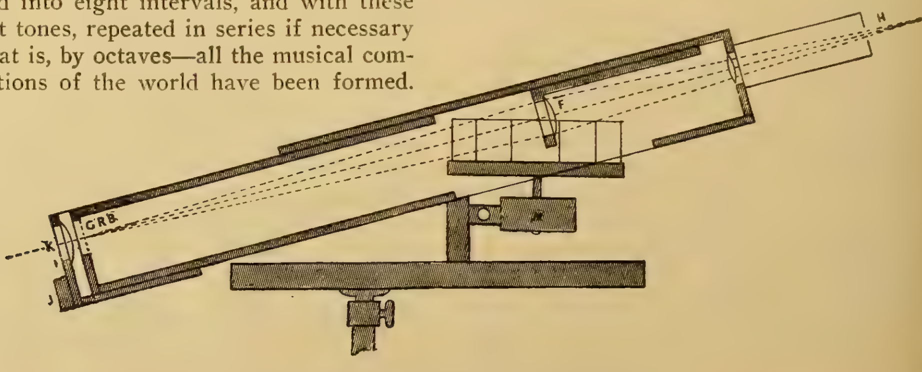


FIG. 3.—VERTICAL SECTION OF COLORIMETER.

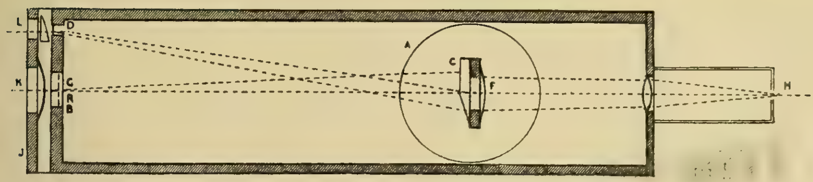


FIG. 4.—HORIZONTAL SECTION OF COLORIMETER.

It will be easier to understand the construction of the instrument if we first become familiar with the principles upon which it is based. The three primary colors are provided by means of pieces of glass with carefully prepared colored coatings. These are placed behind slits which admit light through them. The quantity of light thus admitted will determine the quantity of color seen by the eye of the observer, and this can be regulated and measured by opening or closing the slits, which are arranged side by side.

It remains now only to combine these colors in any desired relation into a single color or tint. This is accomplished by taking advantage of a physiological peculiarity of the eye, scientifically known as "persistence of vision." This refers to the fact that when an object is seen it does not instantly disappear, but gradually fades away, about a tenth of a second being required for its complete disappearance. A familiar example of this fact is the ability to see an object distinctly through the spokes of a rapidly revolving wheel, the impression persisting in the eye during the fraction of a second that it is obscured by the moving spokes. If, then, we present each of the colors to the eye in sufficiently rapid succession—that is, more than ten times a second—they will be blended into a single visual impression—that is, the eye will see a single color made up of the three components.

This is accomplished in the colorimeter by an ingenious arrangement of the lenses mounted upon the circumference of a wheel which is rapidly revolved. Each lens as it passes a slit projects an image of it into the eye, and passing these in sufficiently rapid succession the images blend. It is thus possible to produce a color consisting of one or more of the primaries in all possible proportions, the ratios of which can be accurately measured.

All that now remains is a means of comparing the color thus produced with the color which it is desired to analyze. This is a comparatively simple matter. The instrument is so arranged that the "field" which the observer sees on looking into it is divided into halves, one consisting of the color produced by the instrument, the other the color of the object under examination. To analyze the given color, it is only necessary to adjust the levers governing the proportions of primary colors until the color produced exactly matches the color under examination. The amount of the constituent colors is then read off on suitable scales.

The mechanical details of the instrument will be better understood by reference to the accompanying illustrations. Fig. 1 is a view of it as it appears when it is set up ready for use. The tube at the upper end contains the eyepiece. The three levers terminating at this end furnish the means of adjusting the slits of the color screens. Each of these levers moves over a scale at its upper end divided into a hundred parts, thus permitting the quantity of each color of the compound to be expressed in some number between 0 to 100, or in per cents.

Fig. 2 shows the instrument tilted up, exposing the revolving lenses, which are made to rotate by a small electric motor running on an ordinary dry battery.

Fig. 3 is a vertical section through the instrument, showing the optical arrangement. It will be noticed that the wheel having the lenses upon its circumference is tilted with reference to the axis of the instrument, so that the light only passes through the lens on one side of the wheel.

Fig. 4 is a horizontal section through the instrument, showing the optical arrangement by which the color under in-

spection, which is seen through the opening L, is brought side by side with the colored light produced by the instrument.

The construction will be readily understood by those familiar with optical instruments, and those who are not would not be interested in a further technical description.

By this instrument it is possible to analyze any color whatsoever and express it in terms of the three primary colors,—red, yellow and blue,—the value of each being given numerically. Of course there are many colors which do not contain all three of the primaries, which means simply that the missing colors would be designated by 0; thus ordinary commercial green glass will analyze about as follows: G 36, R 17, B O.

If the theory and general principles of the instrument are now understood, it will be interesting to note a few of the uses to which it can be put. The fact that a color can be accurately analyzed and expressed by a numerical formula will obviate all occasion for dispute as to the matching of colors. This will appeal particularly to those engaged in the textile industries, where the dyeing is very frequently done in a separate house from the weaving and where the matching of the weavers' samples is of prime importance.

A color formula may be preserved indefinitely by simple book record and the color reproduced at any time or place with absolute accuracy. The most elaborate color scheme of a tapestry, wall paper or fabric could thus be recorded permanently and infallibly upon the back of a visiting card, if necessary.

Colors can be described by letter or telegram, and reproduced promptly and without error. An American merchant could thus cable a foreign manufacturer for fabrics of any possible hue, and the manufacturer would know exactly what was wanted. If you wish to add to the marvelous nature of the transaction, consider the message to be sent by wireless.

In short, it enables the whole subject of color to be handled with the same precision, accuracy and despatch that chemical science affords in the steel industries or electrical measurements in electrical industries.

In conclusion, it is only fair to let the inventor be heard in his own behalf. In introducing him to our readers we desire to say that from personal acquaintance, as well as from some degree of familiarity with his past work, Mr. Ives is possessed of the true scientific spirit, which recognizes that scientific truth is no respecter of persons, and that one's own inventions and discoveries must be subjected to the same searching and cold-blooded analysis and experimental proof as those of other scientists. What he has to say of the Colorimeter may be therefore taken as authentic.

"Under suitable fixed conditions of illumination, any one who has become expert with practice can positively determine differences amounting to less than 1 per cent. *This means that a round million of definitely different readings can be obtained.* The three scales of the Colorimeter, each divided into 100 parts, permit of a million different settings on scale numbers, each representing a different hue, shade or luminosity from any other, and each indicated by a simple numerical formula. Three hundred of the scale settings represent as many different hues of pure color, from red through the oranges, yellows, yellow-greens, green, blue-greens, blues, violets and crimsons, back to red.

"It is true that skill and training and the averaging of several determinations are necessary to enable any one to positively identify by the colorimeter the differences between a million different settings; but even a novice, after a few hours, can by single determinations make measurements which will never be 5 per cent. out on any scale, thus positively identifying by *single settings,* 8000 distinct colors. It is only necessary to consider the fact that not even 100 colors can be positively identified by any descriptive color nomenclature to understand the great significance of colorimeter measurements as reference standards of color.

"Take, for instance, the color magenta. It can be described as magenta, bluish magenta, yellowish magenta, very deep, deep, medium, pale, very pale, etc., all more or less indefinite as to interpretation; but the colorimeter will, even in the hands of a novice, unmistakably differentiate a hundred differences in this color, so that they cannot be confused. How much more valuable such a reference than any possible description!"

STREET ILLUMINATION, MISHAWAKA, IND.

A Noteworthy Street Lighting Illumination

Street lighting, in common with other human contrivances and actions, may be noteworthy from various points of view. *Why* a thing has been done is sometimes quite as interesting and notable as *how* it has been done. The case before us is noteworthy from both viewpoints.

There are probably some people in the United States who have never heard of Mishawaka; but this is the fault neither of the business men of the city in general nor of the Dodge Mfg. Company in particular. It is safe to say that there is no up to date user of power to whom the latter concern is a stranger; and if the enterprise shown by the recently organized Business Men's Association is continued the general public will not always need to look in the atlas to learn where Mishawaka is located.

Not all good things come from Indiana; some of them stay there; and one of these is a native tendency to go ahead at top notch speed when once convinced that they are on the right track. Mishawaka has a population of about 12,000, considerably less than that of London, but if Carlisle's estimate of the latter, "A city of 5,000,000 souls, mostly fools," can be considered authentic, is superior to that town in at least one respect. Like most other American cities, Mishawaka, until a recent date, had what passed for a street lighting installation in the form of arc lamps suspended over the streets at uncertain intervals throughout the business section. The business men of the town, however, in their mental vision at least, could see much farther than around the block in which their own particular business was located. With its admirable location and manufacturing facilities, they are ambitious to extend its sphere of influence in this direction, and as a first aid to this laudable project naturally turned to the improvement of its street lighting

An organization was formed and, with commendable family pride, the matter of designing and manufacturing a modern equipment of lampposts was laid before a home manufacturer. From the results shown in the photographs, reproduced herewith, it will be seen that this company, though engaged in a quite different line of work, rose to the occasion in a manner which does credit to their reputation.

The posts are 15 ft. high and are of two designs;

TYPE OF FIVE-LIGHT CORNER POST.

TYPE OF THREE-LIGHT INTERMEDIATE POST.

those in use on the street corners have four arms and one center lamps, while those used along the curb have two arms and a center lamp. From four to six of these posts are placed in each block, with additional ones where occasion may require. The globes are of sufficient size to accommodate tungsten lamps of 25 to 100 watts. The installation covers the entire business section and requires the use of 14,000 lamps. The posts are constructed of steel tubing and wrought iron, supported by a cast iron base, and are painted white. So far as we know this is the only case in the United States where lampposts are painted white, the prevailing color being black, with the occasional use of dark bronze, brown and neutral green. It would perhaps be as difficult to say why lampposts should always be as black as to tell why a

bass viol player is always fat. Why not have white lamp posts? Of course, design would have something to do with color. If a post is of elaborate construction, so as to be essentially a piece of sculpture, then it should have the color of the metal of which it is made; but in posts of simple design, in which the only apparent motive is the mechanical support of the light-sources, there is no particular reason for adhering to the dark colors. The posts used in this installation are exceptionally well designed, and painting them white will in no wise mislead the observer as to the materials or mechanical construction used, and hence is perfectly legitimate from an artistic viewpoint. It may be objected that they will show soil easily, but this is not an unmixed evil; it may be an incentive to a more frequent cleaning of the lamps and globes, as well as the posts. Josh Billings said that a man who could wear a white shirt for a week was not good for anything else; and the lighting installation which is allowed to run without frequent cleaning is nearly as useless.

Artificial Illuminants and Their Color Relations

By D. S. Downs.

Although the scientific principles of artificial illumination are firmly established, the application of these principles in such a way as to obtain the best results in commercial lighting has been neglected until quite recently. Engineers have been engaged chiefly in an effort to improve the efficiency, or light energy emitted per watt input, of illuminants. In their research along this line the equally important problems dealing with the degree of illumination desirable for different classes of lighting, the arrangement of the light-sources for various effects and quality or color characteristics of the light from different light-sources, have been dealt with but meagerly. Illuminating engineers are now, however, rapidly coming to recognize the importance of these factors in illumination, and the improvements recently made in general illuminating effects are probably of greater importance than those in the efficiency of the illuminants.

In this process of the development of illuminating engineering the quality or color of the light emitted by the various illuminants becomes especially important. As a rule we are accustomed to look upon colors of objects as a property of the material itself, while in reality this color is dependent upon the quality of the light in which the object is displayed and the powers of extinction of various rays by the object. In other words, bodies possess the powers of selective absorbtion of light, which fact gives rise to the phenomena of color. When light strikes a body and all perceptible rays are totally absorbed the object is black. When the rays of white light are partially absorbed and all in an equal degree the object is gray, while if the various rays are absorbed unequally or selectively the object is colored, the color depending upon the rays that are reflected to the eye; or in other words, those that were present in the light by which the object was seen, and not absorbed by it. White light, such as daylight, is made up of all of the rays of colors that come within the range of color perception; while artificial lights differ from white light in the proportion of the different colors they contain. The value of an illuminant in places where the distinguishing of colors is of importance is, therefore, dependent upon the nearness with which its light approaches daylight in quality. Consequently, in stores, printing offices and other places where color matching is important, the color or quality of the light should be the first consideration of the engineer.

As an illustration showing the importance of this consideration, the exhibit at the third annual electrical show, Chicago, was especially interesting. Booths containing samples of silk cloth of different

FIG. 1.—SHORT ARC LAMP FOR INDOOR SERVICE.

colors were arranged in a row, so as to show the effect of the various illuminants on the colors. Those compared were the tantalum, Nernst, enclosed carbon arc, Gem metallized filament, tungsten and mercury arc lamps. A study of the results obtained with this exhibit could not fail to impress any one with the marked superiority of the enclosed carbon arc lamp over the other types available, with respect to the color of the light. No perceptible difference could be noted in the colors of the material as viewed under the light of the carbon arc and in daylight.

Although the light from the Nernst lamp is generally thought of as being but slightly removed from that of daylight in color, by this comparison the difference was shown to be quite marked. Violet or blue materials appeared dark and murky in color, yellows were more pronounced and slight variations on the shade of yellows and greens could not be distinguished at all, while white could not be distinguished from the light shades of yellow. The characteristics of the tungsten, tantalum and metallized filament lamps were very similar to that of the Nernst, though even more marked in all cases except the tungsten, which gave an effect not noticeably different from the Nernst. The light of the mercury arc was shown to be such as to make this type of lamp decidedly unsuited for store lighting. Red materials shown varied but little in appearance, all having a dark murky color.

These facts indicate that the types of lamps recently developed will not be serious competitors of the enclosed carbon arc, *where the distinguishing of colors is an important factor.* The problems of obtaining the best light distribution is also one that must always be considered by the engineer in selecting the proper type of illuminant for certain classes of illumination. Often in indoor illumination where the ceilings are low the carbon arc lamp is found unsuitable, because its length does not permit of getting the light at the exact points desired. This one feature of the arc lamp has been the most serious objection to its use in indoor lighting.

In connection with indoor lighting it may be of interest to note how this objection to the use of the enclosed carbon arc lamp in indoor lighting has been overcome by the development of a special type of short arc lamp for indoor service. (Fig. 1.) This lamp is only 20 in. long over all, and will permit of even distribution of light with the lowest ceilings. The glassware used on this lamp is of the same standard size used on the longer lamps, permitting of the use of both long and short lamps in installations without the necessity of carrying two lines of glassware. This lamp burns 100 hours with one trimming, and in no way has the efficiency and utility of the lamp been sacrificed in order to reduce the length. The lamp presents a very pleasing ap-

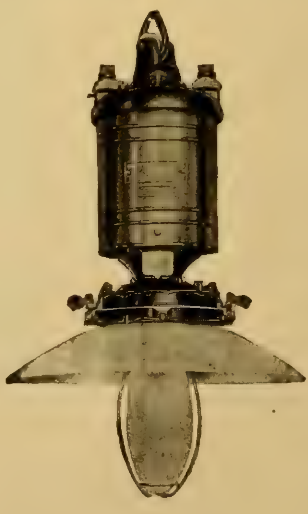


FIG. 2.—ARC LAMP, WITH INDICATING DROP.

pearance, a feature which also adds to its suitability for indoor lighting.

Another feature that has recently been developed is the indicating drop. This feature consists of an indicator which is ordinarily concealed within the case of the lamp, but drops through a slot in the lower part of the case when the lamp requires trimming. (Fig. 2.) This feature is especially valuable where the lamps are not burned for definite intervals of time, and the lamps need not be trimmed regularly. Without such an indicator it becomes necessary to inspect the lamps regularly in order to insure against failure due to the carbons being consumed. However, with the indicator, warning is given before the carbon is totally consumed, and any danger of failure on this account is eliminated. It is also more economical in carbon, for by this system the carbon will be completely consumed in each case, while with the method of trimming at certain intervals of time, and especially where the lamp operates intermittently, it is frequently necessary to discard carbons that would last for several hours if allowed to remain. The lamps are equipped with special coils which protect the lamp from burning out even when on short circuit, and the general design is such that the service is reliable and satisfactory.

The Flaming Arc Lamp as a Street Lighting Unit

By R. F. Pierce.

The history of electric street illumination is practically that of the electric arc lamp. The series incandescent has been, and is, used for certain classes of suburban lighting, but principally as a marker to locate cross streets and cannot be said to possess any real illuminating value in a general sense. Tungsten arches and clusters which have attained some vogue for spectacular and decorative lighting cannot be considered economical illuminants when compared with the more efficient sources of light at the disposal of illuminating engineers. The arch system of lighting partakes too much of the "hippodrome" character to come into general use, and the tungsten cluster which is mounted upon iron or concrete columns is so expensive to install and operate that its use is properly limited to decorative and artistic effects rather than to serious street lighting.

Prior to 1894 the open arc was practically alone in the electric street lighting field. The enclosed arc lamp introduced about that time has steadily ousted the open arc, to the end that the latter is no longer manufactured except to supply the meager demand from a few existing installations.

About 1901 the flaming arc lamp was developed to such a point as to become a commercial factor in Europe; and since this date its use has grown steadily, until practically all of the electric street lighting in Germany is now done by lamps of this type.

It has been argued that European practice is no criterion of the adaptability of the flaming arc lamp to American conditions; it is the purpose of this article to examine into the validity of this objection.

To begin with the parallel comparison of the lamps in question will assist in clearing the ground (see Table 1).

The opponents of the flaming arc lamp point to the similarity of the open arc and enclosed arc in carbon life and cost as indicating that the adoption of the flaming arc to supplant the enclosed arc would be a retrograde step. They assume that these considerations were of foremost importance in the displacement of the open arc by the enclosed arc, calling attention to the fact that labor and carbon cost in Germany are much lower than in America. As a matter of fact, the principal objections to the open arc lamp were the unsteadiness of the light, the wandering proclivities of the arc, and the extremely poor distribution. The unsteadiness of the light was due to a considerable extent to the slight attention paid to the use of sensitive feeding mechanism in American lamps, the manufac-

turers here prefering to use the cheap and simple clutch feed rather than the more sensitive and reliable so-called "clock feed" used in Germany. The dense shadows under the lamp were due in part to the large diameter of the carbons, but principally to the very short arc length, which latter consideration also intensified the variation of light caused by the wandering of the arc. It was also the invariable custom to use clear globes on open arc lamps, and the open arc was debarred from enjoying the advantages which might have been obtained from the use of diffusing glassware.

As seen in Fig. 2, the illumination given by the enclosed arc was, in spite of the lower efficiency of the lamp, greater between the most important points than that from the open arc. The superior efficiency of the open arc was, therefore, more than nullified by the nature of its distribution curve. It is worth noting in passing that the most glaring defects in the open arc lamp were purely domestic in character; in fact, they had by proper design and the use of diffusing glassware been overcome in Germany to such an extent that the enclosed arc lamp never obtained any substantial foothold in that country.

With reference to this we quote the following from Dr. Louis Bell, who recently returned from a European trip, upon which he inspected the most prominent street lighting installation in Europe*: "The enclosed arc lamp that has been considered the standard in this country has never been adopted for general illumination abroad." Dr. Bell explained that the inability to obtain suitable electrodes at a reasonable price was the chief cause for the adoption of the enclosed arc lamps. In America at the present time the highly efficient yellow flaming arc lamps, both with vertical and inclined electrodes, are displacing the older open arcs.† "The foreign open arcs, thanks to high grade carbons and sensitive feeding mechanism, are substantially as steady as American enclosed arcs."

The ousting of the open arc in America was, therefore, purely a matter of "over all" economy, and the economies

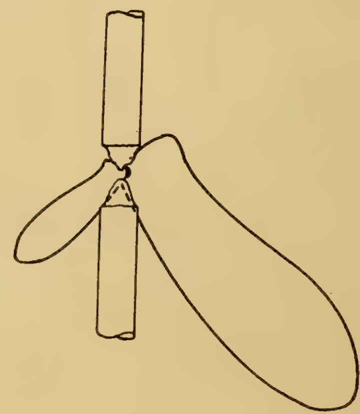


FIG. 1.

TABLE I.

OPEN ARC.	ENCLOSED ARC.	FLAMING ARC.
High efficiency, about double that of the enclosed arc.	Low efficiency, but slightly higher than that of the tungsten.	Very high efficiency, about eight times that of the enclosed arc.
Short carbon life, about 10 hours per trim.	Long carbon life, about 75 hours per trim	Short carbon life, about 18 hours per trim.
Expensive carbons, about 5 cents each.	Cheap carbons, about 2½ cents each.	Very expensive carbons, about 15 cents per pair.
Extremely poor distribution of light, deep shadows immediately under the lamp surrounded by ring of brilliant illumination outside of which the illumination is of a very low intensity.	Fair distribution of light.	Excellent distribution of light when used with prismatic inner globes.
Very unsteady light caused by great variations of arc length between pick up and feeding, and also on account of the wandering of the arc.	Unsteady light, but much better than the open arc.	Very steady light.
Dazzling white light.	Cold bluish white light.	Well diffused yellow light.

* *El. World*, Feb. 25, '09, p. 487. Report of paper by Dr. Bell before N. Y. Elec. Soc., Feb. 17, '09.

† *El. Review*, Mar. 13, '09, p. 469, "Street Lighting," by Dr. Louis Bell.

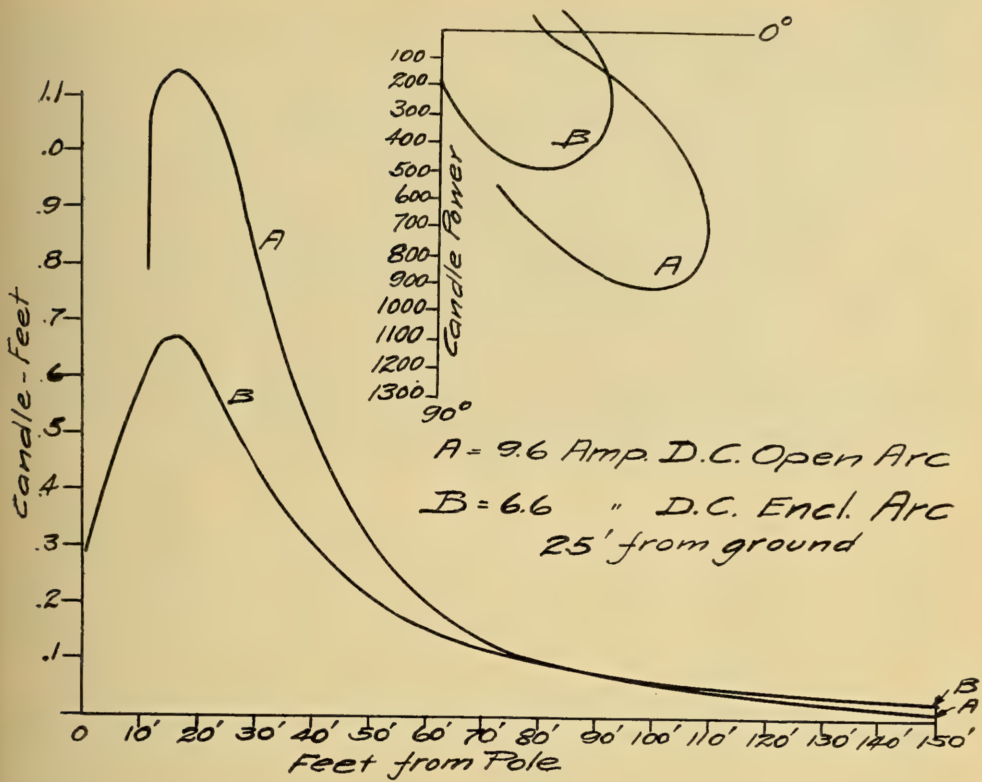


FIG. 2.

in the matter of labor and carbons were merely incidental. It is absurd to contend that it is good policy in Europe, but bad policy in America, to expend one additional dollar's worth of labor to save three or four dollars' worth of current.

That the flaming arc lamp is economical and commercially practicable under American conditions is amply proven by the rapidity with which it is replacing the enclosed arc in industrial plants in this country, where the item of labor is of as much importance as in central stations and municipalities, and where ultimate economy receives just as much consideration. For the benefit of those who have been unable to keep closely in touch with arc lighting developments, it might be well to state that the flaming arc lamp is practically established as the standard illuminant for mill type installation buildings, where high efficiency units may be utilized. This is particularly true in the iron and steel trade; and it is no exaggeration to state that there is scarcely a steel mill building of any importance under construction to-day for the lighting of which anything but flaming arc lamps is being seriously considered. The same is true in the foundry trade.

The flaming arc lamp has suffered somewhat in the past from the fact that its introduction in America was made under the auspices of theatres and amusement parks, and the general public has been prone to believe that its proper sphere was limited to uses of the more or less spectacular nature. This opinion was quite in line with that of most of the leading engineers four or five years ago, and the recent progress of the flaming arc lamp for installation lighting is the strongest evidence that it may be expected in the future to play an important part in street lighting in opposition to the contrary notwithstanding.

That the prevailing notion that the cost of carbons and the trimming labor pro-

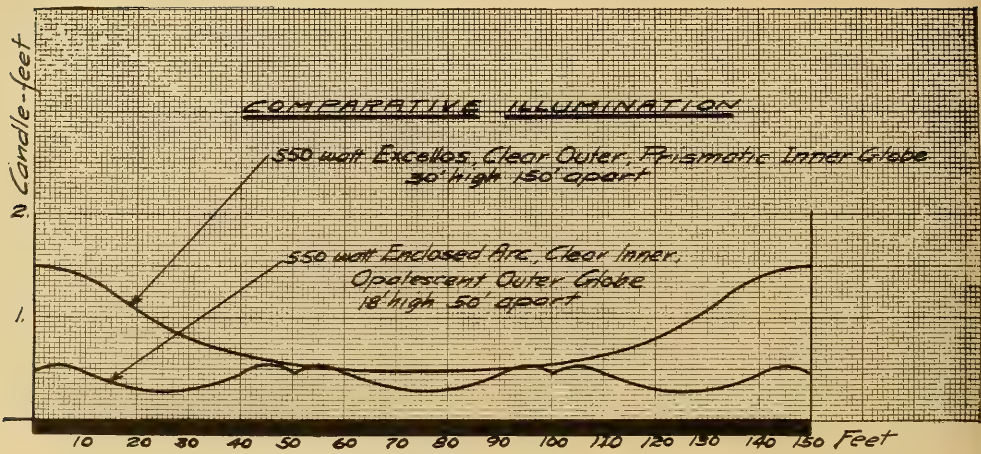


FIG. 3.

hibits the use of the flaming arc lamps for commercial street lighting is erroneous, the following table referring to Fig. 3 demonstrates:

COMPARATIVE EXPENSES FOR ONE YEAR (4,000 HRS.).

	One enclosed arc.	One flaming arc lamp.
Voltage	110	55
Amperage	5	10
Glassware inner	Clear.	Clear prismatic.
Glassware outer	Alabaster.	Alabaster.
Current consumption per 4,000-hr. year—kw. hours	2,200	2,200
Cost at 2 cents per kw. hour, Item 2	$44.00	$44.00
Capital expense:	Encl. arc.	Excello.
Cost	$16.00	$57.71
Depreciation at 25 per cent. per year	$4.00	$14.43
Interest at 5 per cent. per year	.80	2.89
Item 3	$4.80	$17.32
Maintenance:		
Carbon cost per trim	$0.0245	$0.11375 av.*
Carbon life, hours trim	77	10 and 15
Trims per year	52	365
Carbon cost per year	$1.28	$41.52
Trimming labor at 2¼ cents	1.17	8.21
Economizers at 20 cents	..	.80
Repairs	.75	.75
Inner globes	.30	.42
Outer globes	.15	.40
Item 4, totals	$3.65	$51.90
Maintenance, 4	$3.65	$51.90
Capital expense, 3	4.80	17.32
Energy, 2	44.00	44.00
Grand totals	$52.45	$113.22
Total yearly cost per lin. foot	$1.049	$0.754
Minimum illumination in candlefeet	.3	.5
Total yearly cost per lin. foot per candlefoot minimum	$3.496	$1.508

* Based upon the use of 10-hr. carbons during one-half of the year and 15-hr. carbons the remaining half.

In the above calculations the maintenance cost of the ordinary enclosed arc is calculated from figures contained in a paper read by Mr. S. G. Rhodes before the National Electric Light Association in 1904 (N. E. L. A. proceedings 1904, page 129), and from a paper read by Mr. L. B. Marks before the same body in 1906 (N. E. L. A. transactions 1906, page 64). That the enclosed arc lamp costs are at least conservatively low is evident by comparing the total cost of the above with the price per lamp paid by American municipalities under existing contracts with central stations. Carbon costs for the flaming arc lamp have been compiled from current prices, and burning hours obtained in practice. The energy consumption has been taken at the rated ampereage of the lamp, from which it will not vary in practice more than 5 per cent. in either direction if properly adjusted. The figures for repairs and depreciation are based upon those given for the enclosed arc lamp, but as a matter of fact the flaming arc lamp in practice is found to require much less frequent repairing, and has a considerable longer life, than the commercial enclosed arc lamp. The illumination calculations have been drawn from photometric tests, which have been carefully checked with corresponding tests made by the Electrical Testing Laboratories, New York, and the Westminster Laboratories of London.

It might further be stated that these distribution curves have been used for a considerable time in designing industrial

plant lighting installations, and have been found to give satisfactory results in practice.

The table above clearly shows that an increase in minimum street illumination of about 65 per cent. may be accomplished by the substitution of flaming arc lamps for enclosed arc lamps, and at the same time a substantial saving in operating cost is effected.

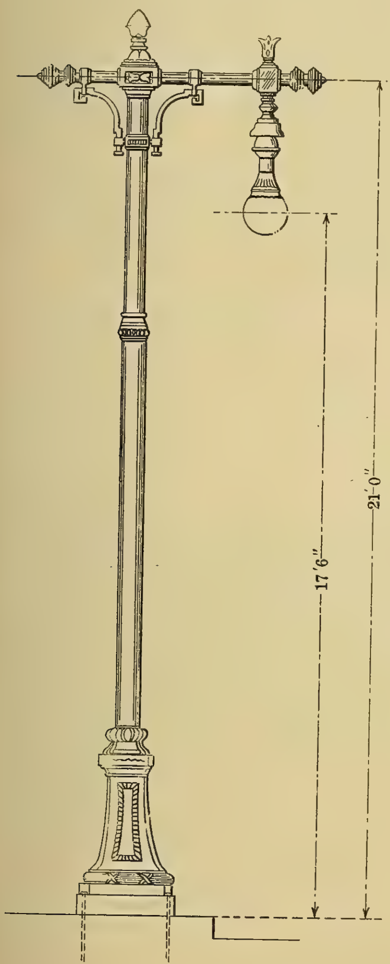


FIG. 1.—TYPE OF POLE INSTALLED BY DOWNTOWN LIGHTING ASSOCIATION.

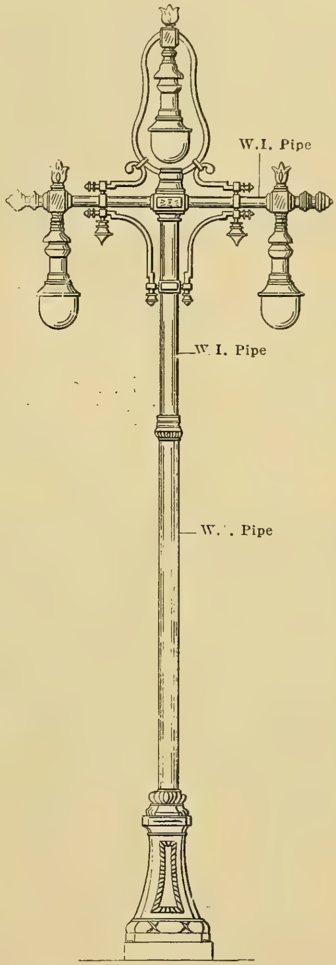


FIG. 2.—TYPE OF POLE INSTALLED BY CITY IMPROVEMENT ASSOCIATION.

The New Street Lighting Installations in St. Louis

The question of lighting, both public and private, has been a sort of "continuous performance" in St. Louis for several years past, the newspapers, the courts, civic organizations and private citizens all coming on the stage at irregular intervals with some new and original "stunt." That all the play and by-play has not been vaudeville, however, is evidenced by the fact that two strictly modern installations of street lighting are now being put in as the result of the activity of two different

business men's associations—the Downtown Lighting Association and the City Improvement Association.

These organizations are interested in different areas of the business center of the city. The installation which is being put in under the direction of the Downtown Lighting Association covers an area of approximately 1800 by 3000 ft., within which the present system, consisting of 138 D. C. series arcs, is to be replaced by 400 magnetite arcs of the 480 watt type. The post to be used in this installation is shown in Fig. 1. The association furnishes these posts, the city paying for the current under its regular contract.

The installation put in by the City Improvement Association covers the section of Broadway from Washington avenue to Elm street. The posts, shown in Fig. 2, carry three magnetite arcs, and are placed approximately 50 ft. apart on each side of the street. The association pays for both the installation and its maintenance, including current. The mercury arc rectifier system is used with both installations.

Spectacular Lighting in Poughkeepsie During the Firemen's Convention

By E. Mandeville.

The great English critic, Matthew Arnold, declared in his day that what the world most needed was "sweetness and light." Poughkeepsie, as the seat of Vassar College, has long been well supplied with the former; and on the recent occasion of the Firemen's Convention, held within its gates, presented such a specta-

FIG. 1.—STREET ILLUMINATION, MAIN STREET, POUGHKEEPSIE.

FIG. 2.—TEMPORARY LIGHTING, MAIN STREET, POUGHKEEPSIE.

cle of the latter as would have made the renowned critic rub his eyes in amazement—as indeed it did many of our citizens and visitors, of whom we entertained some 40,000.

The principal feature of the decorative scheme was the Court of Honor, which was formed in Market street, our most prominent thoroughfare. This consisted of decorative columns adorned with baskets of flowers at the top and connected with festoons of electric lamps. A night view of these is shown in Fig. 1. Beside this a long section of Main street was brilliantly lighted with double festoons of incandescent lamps strung from temporary standards placed along the sidewalks, as shown in Fig. 2. The Municipal Building, the fire company's stations and business blocks throughout the section were all elaborately draped, and outlined with a liberal use of lamps, for which purpose nearly 20,000 were required. Fig. 3 shows the illumination on the front of the office of the Poughkeepsie Light, Heat and Power Company.

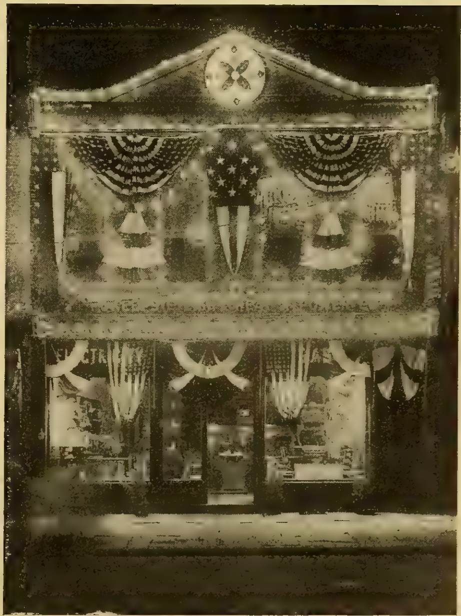
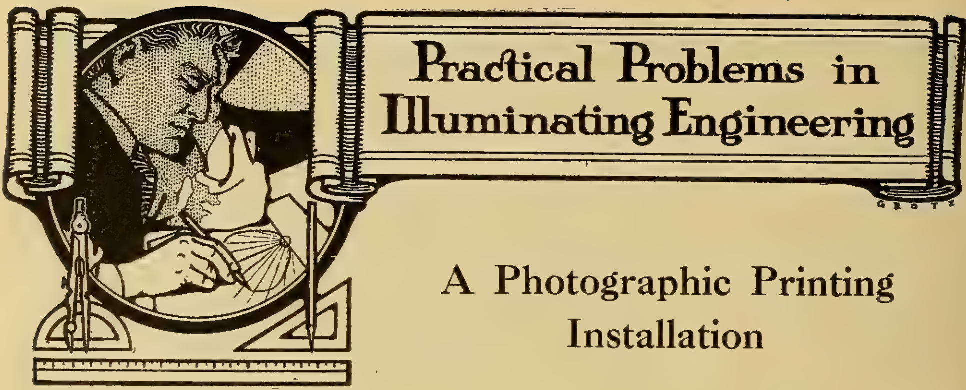


FIG. 3.—POUGHKEEPSIE LIGHT, HEAT & POWER COMPANY'S OFFICE.



Practical Problems in Illuminating Engineering

A Photographic Printing Installation

Atlantic City, while noted for its boardwalk, bathing beach and fair bathers, might also make claim for novelty photographs. Every day is a holiday for those who make this city possible with their "go easy" money. You may enter any one of the many galleries along the boardwalk, leave your name and address with the optimistic young lady at the desk—she was never known to say other than, "They are fine pictures; I think the expression is particularly good"—step into the rear section and "look pleasant for a moment, please," and be told to return in the course of an hour for the finished photos.

Artificial light for photographic work has always belonged to the electric sources—possibly by right of discovery, probably because of the actinic quality of the light from mercury tubes and high voltage arc lamps, and because of the large quantity or total flux of light from these sources.

In some of the galleries four mantle inverted gas lamps similar to Fig. 1 are used for printing. This lamp, equipped with the mirror reflector shown—which, by the way, was not designed for this work, but for show window lighting—is installed as shown by plan and elevation drawings, Fig. 2. On inquiry, the pro-

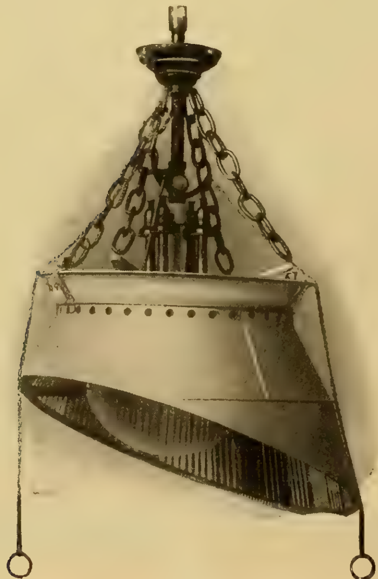


FIG. I.

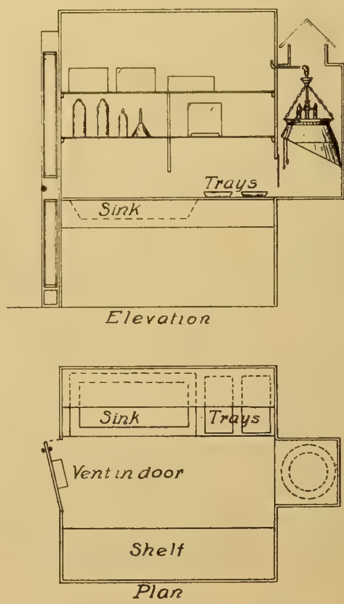


FIG. 2.

prietor of the gallery stated that he found the light from this lamp more satisfactory than either the electric arc lamp formerly used or daylight. The latter varies considerably in intensity throughout the day and also changes rapidly from time to time with various cloud formations. The electric arc was far from steady, and they could not always be sure of which side of the carbons it might be on. For prints exposed some minutes or even seconds these changes would not be important, but for the work in Atlantic City, seconds are definite intervals of time.

The printing record of this particular gallery—1000 3½ x 5½ in. prints, printed and developed, with one operator and an assistant, in 56 minutes—was made with the equipment shown.

The lamp is used without a globe, and the heat from the combustion of the gas offers an excellent substitute for the electric fan otherwise necessary to insure proper ventilation in a dark room, which is used many hours per day. This lamp, encased as shown, with a ventilator on the top of the galvanized iron box, all of which is outside of the building proper, affords all the ventilation desired. Fresh air is admitted through a light-trap in the bottom of the door. The lamp enclosure acts as a stack and the positive circulation of air results in an increase in the candle power of the mantles. The intensity at approximately 14 in. below the mantles, where the printing frames are exposed, showed, by illuminometer measurement, an average of 1200 foot-candles.

As stated in the recently issued Electrical Solicitor's Handbook, "Imitation is the sincerest form of flattery," but to displace both an electric arc lamp and an electric fan with a gas cluster lamp can hardly be labeled "imitation."

The Lighting of a Tailor Shop—A Solution of the Problem Submitted in the August Issue

By A. L. Eustice.

The problem represented by the illustration on page 305 of the August Illuminating Engineer requires an analysis of the rather exacting conditions so often found in a typical small tailor shop.

While much of the necessary information to properly solve such a problem is given, yet several essential details, such as color of walls, cost of current, etc., can only be assumed, and a scheme must be devised to properly illuminate the shop in question from a study of the picture.

In the design of this system many important factors must be considered in order to insure a satisfactory installation from the viewpoints of the owner, designer and the manufacturers of the lamps employed; of which the following predominate:

1. A high intensity must be provided in view of the general dark nature of the walls and material displayed, and also to meet the exacting demands at the cutting and sewing tables where dark colored materials are handled.

2. A high standard of diffusion is imperative; hence, the use of small or medium size units is evident.

3. The color of the light must be as near daylight as possible.

4. The efficiency of distribution of units must be high in order that the installation can be made at minimum expense.

5. The units employed must be neat, ornamental and attractive in appearance.

6. The units adopted should have the lowest operating cost, without sacrificing the above factors, including: (a) Efficiency or cost of current consumed; (b) cost of renewals or maintenance.

7. First cost of lamps or investment should be a minimum (quality considered).

(Investment is the item of least importance, because any justified difference in first cost is based on the relative total cost of operation consisting of items A. and B.)

With the above factors in mind, it is assumed that a mean intensity of 6 foot-

FIG. I.—THE TAILOR SHOP.

candles will be entirely adequate for the severe demands of the shop pictured and it is determined to employ Westinghouse Nernst lamps.

In the opinion of the writer, if Westinghouse Nernsts are used in medium or small sizes the average intensity of 6 foot-candles would be maintained, under normal operating and maintenance conditions, allowing for losses due to unclean glassware, etc., at an efficiency of 3 1-3 lumens per watt; that is to say, for each watt per square foot of energy expended an intensity of 3 foot-candles will be resultant.

Hence the following figures are in order:

Size room, 20 x 40 ft.
Area, 800 sq. ft.
6 ft. candles divided by 3.33 equals 1.8 watts per square foot.
1.8 w./sq. ft. × 800 equals 1.440 kw. connected load.

Watts per lamp...	132 watt.	176 watt.	2 glower.
Units required....	11	8	5.4 (6)

A glance at the picture Fig. 1 and plan will show that the required 11-132 watt single glower units work into the scheme without difficulty and will best serve the purpose, for consideration must be given to the present ceiling construction, which provides three ornamental rosettes down the center line of the room and the use of these designs for the location of an outlet will add to the artistic appearance of the interior.

The outlets are arranged as shown in the plan, the distance from the walls being selected at approximately 5 feet 6 inches, so that the units will be near the edge of the tables. Such an arrangement will eliminate objectionable shadows of customers and workmen when leaning over the stocks and is to be recommended.

In regard to height, the distance from lamp to floor in such cases where surroundings are generally dark should be approximately 10 feet, although the increased appearance effected by the raising the units may make it desirable to increase the height to 11 or even 12 feet, supporting the lamp on a small but neatly designed pendant.

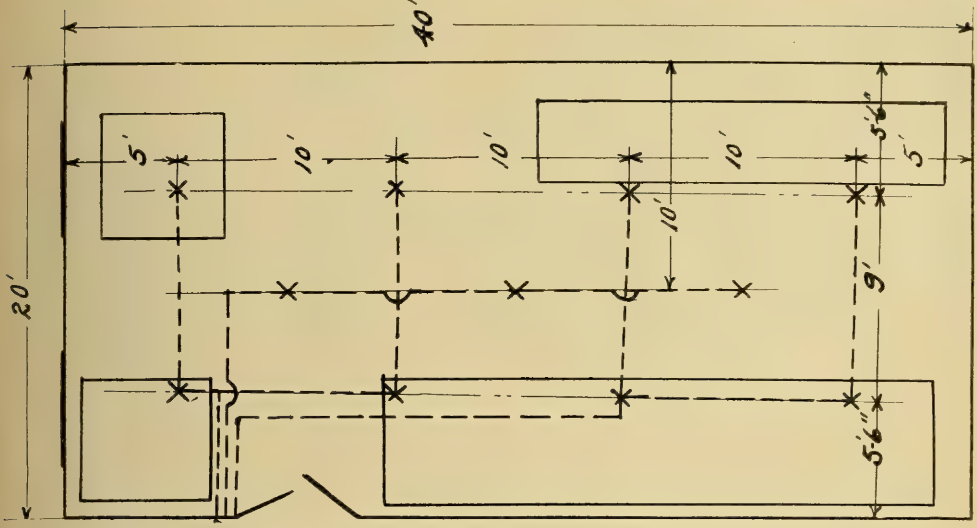


FIG. 2.—ILLUMINATING PLAN. (X) 132 WATT NERNST SINGLE GLOWER UNITS.

The quality of the light is a very important factor, especially in tailor shops, where dark colored goods are displayed. The superior quality of light from the Westinghouse Nernst lamp, if for no other reason, at once gives that lamp the preference over all other incandescent lamps, for from the standpoint of colors there is but little choice between the short carbon arc, the high quality Welsbach gas mantles and the Westinghouse Nernst lamp with blue glassware.

In presenting such a plan to the owner the total operating costs and investment involved are generally the items which are of great interest and are the chief determining factors in the final decision. The installation herein outlined, as seen below, will appeal to the average lamp buyer:

Number 132 watt Westinghouse Nernst required	11
List price per unit	$7.50
Discount (for less than $250)	55 %
Net price per unit	$3.375
Total investment, lamps only	$37.13

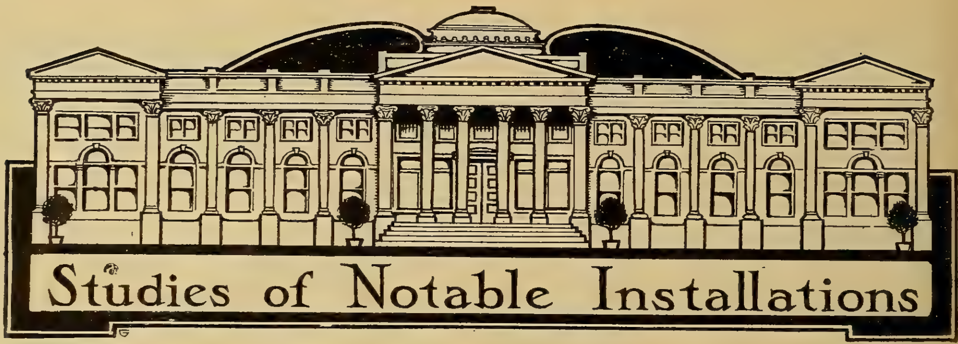
The average burning hours for such a shop will be approximately 4 hours per day or 100 hours per month, and with this as a basis and an assumed cost of current of 10 cents per kilowatt-hour the following summary indicates the total operating expense per month:

Connected load	1.452 kw.
Total consumption per month	145.20 kw.
Cost of current per month	$14.52
*Cost of maintenance per month (.005 per kw. hour)	$0.73
Total operating cost	$15.25

Economy in the operation of this system can be further effected by installing a system of wiring shown in the plans which provide three circuits, of which one controls the center lights, one the four rear lights and the third circuit the four front lights. With this arrangement the one rear circuit only need be in operation on bright days when business or work is slow, and can be supplemented, if desired, by the three center lights, holding the front circuit in reserve for dark and busy days and night service.

The investment and operating expense of a modern Westinghouse Nernst system of illumination is such a trifling sum, when the great increase in illumination, appearance and efficiency of labor are secured, that there appears to be no legitimate reason for the existence of the great number of miserably lighted stores of which the picture above is a good sample.

* Maintenance on the average Nernst installation is approximately one-half cent per kilowatt hour; the exact sum depending on the location and cost of labor, and in specific installations, the maintenance cost is guaranteed by the manufacturers.



The Seats of the Mighty

(Concluded.)

The drawing room in the villa of Mrs. William Astor, shown in Fig. 1, follows in both the spirit and the letter the decorative motives of Louis XV. Crystal chandeliers with imitation candles are used, supplemented by wall brackets simiiarly equipped. The only incongruity here is the use of round frosted electric lamps. This is a common error with fixture manufacturers. Such lamps, in common parlance, "give the whole thing away." The wax candle can be accurately imitated with a piece of opal glass tubing, but the round electric lamp has about as much resemblance to a real candle flame as the leaning tower of Pisa has to the the Venus of Milo. Miniature electric bulbs are made expressly for this purpose, and give a fairly close simulation of the candle flame; and why they are not used in installations of this type is one of the unsolved mysteries.

Fig. 2 is a view of the drawing room in the villa of the Hon. Perry Belmont. The furnishings partake of the French "periods," but are less distinctly marked. The crystal chandeliers are magnificent specimens of their kind; and the kind is very good. The candles are supplied with gas tips, which give a satisfactory substitute for the flame of the actual candle.

The dining room in Mr. E. D. Morgan's villa is shown in Fig. 3. Mr. Morgan's prominence and interest in yachting affairs is plainly shown by the numerous trophies here displayed. The lighting is somewhat peculiar. We may first note the absence of the conventional "dome," or central chandelier of any kind. Clusters of three frosted electric lamps will be seen above the capitals of the pilasters. The only supplementary illumination is from the beautiful candelabra on either side of the fireplace. We opine that fixture manufacturers will hold this installation in very low esteem.

Fig. 4 shows the reception room in the villa of Mr. Henry Seligman. The architecture is purely and severely classical, and the lighting fixtures are as distinctly of the Pompeian type. The chandeliers represent ancient Roman lamps, but the delusion is unfortunately nearly dispelled by the presence of the modern electric lamp socket and bulb in place of the oil flame of the original. This is another inexcusable blunder on the part of the designer. At least the socket should have been concealed in the support, and a flame shaped lamp should have been used in place of the commercial 16 c. p. bulb. When will fixture designers learn that wearing sweaters with dress suits spoils the harmony of the combination, and contravenes the canons of good taste?

The two standards on the mantle follow closely the Pompeian models, and have the virtue of frankly disclosing their use of modern light sources by being equipped with present-day globes. The large standard at the right is equipped with globes intended to imitate the flame of a torch; and if one wants imitation this is just the thing that is wanted.

Fig. 5 shows the dining room in the same villa. Here we step forward a

FIG. I.—DRAWING ROOM, VILLA. MRS. WILLIAM ASTOR, NEWPORT.

FIG. 2.—DRAWING ROOM, VILLA. MRS. PERRY BELMONT, NEWPORT.

FIG. 3.—DINING ROOM, VILLA. MR. E. D. MORGAN, NEWPORT.

FIG. 4.—RECEPTION ROOM, VILLA. MR. HENRY SELIGMAN, NEWPORT.

FIG. 5.—DINING ROOM, VILLA. MR. HENRY SELIGMAN, NEWPORT.

couple of thousand years and find ourselves again in the time of the Louis. The chandeliers are strictly modern adaptations of the most modern of our light sources. Luminous fruits and flowers came into existence with the electric light, and have no prototype in ancient or medieval devices. What an infinite pity it is that the electric light had not been discovered in the time of Le Brun! What a wealth of beautiful creations in illumination that genius of art and his colleagues would have evolved; and what endless repetition of porcelain "candles" we would have been spared! When will the genius arise among us who can think and see as Le Brun thought and saw, instead of merely clothing himself in garments of the same cut?

In this cursory inspection of these modern palaces, the one thought that must occur to the observer, when the general impression of magnificence has subsided, is the absolute lack of originality in architecture, decoration, and lighting equipment. The most recent of the artistic motives dates back at least two centuries, and the oldest more than two thousand years. That no little skill in craftsmanship, and cleverness of judgment in adaptation has been used cannot be denied; but of real creative genius there is not a scintilla of evidence. Greece, Rome, Pompeii, Paris: the art and the luxury suggested by these four cities is represented, but of modern, not to say American thought and feeling and habits of life there is as little expression as there is in the faces which children cut in pumpkins for Hallowe'en.

May we not be allowed to draw a final moral of universal application: wealth can neither produce nor purchase genius.

Theory and Technology

Plain Talks on Illuminating Engineering

By E. L. Elliott.

No. XXII. Exterior Lighting Fixtures.

The subject of exterior lighting fixtures—which is concerned chiefly with what are commonly called lampposts, but also includes brackets, and occasionally cable suspension—is one which has sprung into a place of first importance within the past two years. The old-fashioned lamppost, which supported either a metal lantern having glass panes, or a so-called "boulevard globe," as a protection against the weather to the flame gas lamp, is a familiar sight to every one who has even had a single glimpse of a city or town.

The lampposts that had served long and adequately for gas illumination were wholly unfit to support the arc lamp when it first came into use for street lighting; and the substitutes and makeshifts which were pressed into service were of too nondescript a character to admit of classification, varying from the enormously high steel tower to a small bracket on the side of a telegraph pole. No scientific improvement in a public utility was ever embodied in an uglier form than the arc lamp; nor, we may add, was ever more misused in its application. Such monuments of crudity as the average arc light installation of twenty-five years ago, however, are peculiar to America; the finer sense of the eternal fitness of things in Europe prevented any such monstrosities.

With characteristic American impetuosity we have suddenly discovered that street lighting fixtures have much to do with the appearance of city streets, apart from the illumination afforded, and the popular edict has gone forth to hurry these relics of vulgarity to the scrap heap and put something befitting our modern ideas of culture and wealth in their places. In our haste to accomplish this we have sometimes produced results not unlike what might follow if an assortment of modish clothing were distributed to a savage tribe; but even the donning of a

WOODEN LAMPPOST WITH BRUSH ARC LAMP.

FIG. I.—GAS LAMPPOST, PARIS.

verge of ugliness. The design shown in Fig. 1, which is a standard gas lamppost in the city of Paris, cannot be criticised for either too much or too little elaboration. While plainly expressing in its construction the mechanical necessities for its existence, the excellent proportions and simplicity or the ornamentation commend it to careful consideration. Any considerable excess of decoration beyond this would look out of place, while any stripping of the ornamentation shown would give a sense of nudity. There is no opportunity for any considerable divergence from this general type in the use of the single mantle burner or gas flame.

When it comes to supporting a light-source in a pendant position there is a greater latitude of choice. The different methods may be classified as follows:

silk hat and bathing trunks is an evidence of progress.

Since the question of lighting fixtures is now concerned quite as much with art as utility, their merits and demerits have become a matter of opinion as well as of fact; and there are generally nearly as many different opinions as there are different individuals. We can, therefore, only hope to get at a few fundamentals.

Whether utility or art be considered, the first question to be decided is whether the light-source is to be supported in an upright or pendant position. In most cases the source itself decides this, as with the gas flame and the upright mantle burner, which must have an upright position, and the inverted gas burner and the arc lamp, which must have a pendant position, leaving the matter of choice to those cases in which the incandescent electric lamp is used.

There will probably be little dissent from the statement that, however other conditions may vary, the decorative treatment is limited by the size and character of the light-source. An elaborate or massive post to support a single gas flame or mantle burner would be a manifest absurdity. It does not follow, however, that such a post need to be plain to the

FIG. 2.—STANDARD, BISHOP'S CROOK POST, NEW YORK CITY.

FIG. 3.—STANDARD QUADRANT POST, NEW YORK CITY.

The goose-neck, or bishop's crook;
The lyre;
The mast arm, or bracket.

The first of these is a very familiar type and may be found with a variety of embellishments, in all of which the curve of the crook itself is the principal line of beauty. The only satisfactory curves are the semicircle, as shown in Fig. 2, or the quadrant, as shown in Fig. 3. All sorts of curliques in the way of ostensible additional support are used. The general type is always pleasing unless overdone, and has the advantage of placing the light-source beyond the curb.

The lyre type, shown in Fig. 4, is equally satisfactory in principle, "filling the eye" with its mechanical completeness and susceptible of an artistic turn by the mere curvature of the supports. Additional detail can be added, but this must be done with caution, for it is easily overdone.

The mast-arm is a bracket with an extra long projection, and is an exceedingly difficult construction to embody in a decorative design. This perhaps arises from the fact that the mechanical necessities of the case embody two straight lines at right angles, a figure which is absolutely devoid of beauty; and to attempt to convert this geometrical axiom into a poem is almost as difficult as the proverbial task of making a silken purse out of a sow's ear. It would perhaps be straining the point to add that the construction is painfully suggestive of the old time gibbet, with which no one cares to acknowledge an intimate acquaintance. Figs. 5 and 6 show two fairly creditable attempts to master the problem.

Fig. 7 shows a rather unique scheme of avoiding the rectangular construction by ostensibly counterbalancing the weight of the lamp by enlarging the projecting

FIG. 4.—STANDARD LYRE POST, NEW YORK CITY.

FIG. 5.—STANDARD MAST ARM POST, NEW YORK CITY.

end of the arm, and also by giving the arm a curved form. While opinions will differ, it strikes us that the solution is quite successful.

In all the cases thus far shown a single lamp or light-source is used, and following the principle first set forth, the artistic treatment is limited. Where greater decorative effect is required than this, it is plain that more than one light unit must be supported by the fixture. "More than one" means any number from two to infinity; the choice of numbers is therefore unlimited. The only question in controversy in this case is between the utilitarian results and the artistic effect. Any illuminating engineer, or even near-illuminating engineer, will at once tell you that you will get better illumination by evenly distributing your sources than by using them in clusters; and there is no denying the truth of the statement. As in most cases of controversy, the result is usually a compromise. The number of lamps used on a single post rarely exceeds five, and is more often reduced to two.

For some reason there seems to be an abiding tendency among architects to place all light-sources in an upright position. This is probably a lingering tradition of the ancient torch or flame source. Whatever reason or argument may be brought forth to justify this arrangement from the artistic side, it is indefensible from the utilitarian standpoint. A light-source is invariably placed above the objects to be illuminated, and the simplest reasoning shows that supporting them from below obstructs the passage of the light to a greater or less extent and hence interferes with their greatest usefulness. Fig. 8 is a typical example of this kind, of which there are many others.

A similar installation was so severely criticised by Dr. Bloch in our last issue. From a purely engineering standpoint there is no question that these lamp-posts are open to serious objection. The upright position of the lamp, the massive arms underneath, and the clustering of five sources so near together combine to produce a very considerable interference with the illumination of the pavement.

A very similar installation in Los An-

FIG. 6.

geles, which was probably the first of its kind installed in this country, caused no little dissatisfaction after the novelty of its striking appearance had worn off, on account of the cost of maintenance.

The posts are acceptable enough as pieces of sculpture or art metal work, but the fact must not be overlooked in considering lampposts as architectural embellishments that they become absolutely devoid of any such quality by night. The contrast between the brilliancy of the light-source and the comparatively dark shadow of the post throws the latter into an obscurity that effectually obliterates all traces of art. A night view of the installation shown in Fig. 9 proves this point.

The few typical cases that we have taken up show clearly enough that the subject of the design and construction of lampposts has by no means been exhausted; indeed, it would be quite impossible to point at any particular post among those illustrated, or the innumerable variations of their types, and say, " here is a perfect post." What is more, such a state of affairs is never likely to occur; for so long as art has any part in the construction of a post, so long there will be radical differences of opinion as to its merits.

A more important lesson to be drawn from the discussion is, that the principles of illuminating engineering cannot be ignored, no matter what the demands for art may be.

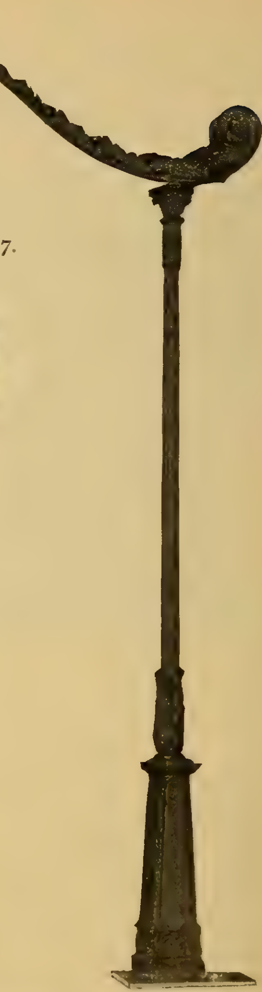


FIG. 7.

FIG. 8.

FIG. 9.—BROADWAY AND FIFTH STREET, LOS ANGELES.

The Illuminating Engineering Society Convention

The time and place of meeting of the Third Annual Convention of the Illuminating Engineering Society were announced in our last issue. Following is the programme and list of papers and reports to be presented:

PROGRAMME.

MONDAY, SEPTEMBER 27TH.

Afternoon.

Opening Session, 2 P. M.

Address of Welcome, T. Commerford Martin

Response, Walton Clark

President's Address, W. H. Gartley

Reports of Committees:

On Nomenclature and Standards, Dr. A. C. Humphreys, Chairman

On Division of Membership, E. L. Elliott, Chairman

Evening.

Musicale in the Auditorium, followed by a reception in the Assembly Room.

TUESDAY, SEPTEMBER 28TH.

Morning.

Review of the historical parade in connection with the Hudson-Fulton celebration.

Evening.

Session for the presentation and discussion of papers at 8 P. M.

WEDNESDAY, SEPTEMBER 29TH.

Morning.

Session for the presentation and discussion of papers at 10 A. M.

Afternoon and Evening.

Session for the reading and discussion of papers at 2 P. M.

Arrangements for the entertainment of the lady guests, and for a general inspection of the illumination in the evening will be announced later by the Entertainment Committee.

PAPERS.

The following list includes papers that are now being prepared for presentation. It is probable that others will be added to this list:

Ethics of Illuminating Engineering, E. L. Elliott

Notes on Illuminating Engineering Practice in Europe, H. Thurston Owens

The Importance of Illuminometry in Practical Illuminating Engineering, Norman Macbeth

Efficiency of Lighting Installations, A. L. Eustice

Shades and Reflectors, Dr. Louis Bell

The Design of Reflectors, A. J. Sweet

Diffusing Mediums, A. J. Marshall

Factory and Mill Lighting, L. B. Marks

The Photometric Laboratory of the United Gas Improvement Co., C. O. Bond

The New Physical Laboratory of the National Electric Lamp Association, Dr. E. P. Hyde

The Light of the Firefly, Ives and Coblentz

Notes on Chemical Luminosity, Dr. Angelo Simonini

The Problem of Heterochrome Photometry, P. S. Millar
Description of a Demonstration Lighting Installation, W. C. Morris
Discussion of the Efficiency of the Moore Light,
Messrs. Hyde, Woodwell, Sharp and Millar

EXHIBITION.

The exhibition feature of the convention, which was so successfully introduced last year, will be extended in scope during the coming convention. The committee have been fortunate in securing the use of the building at 5 West Thirty-ninth street, about midway between Fifth avenue and the Engineering Societies' Building. This building was especially fitted up and occupied for a number of years by a prominent manufacturer of lighting fixtures, and is admirably adapted to the purpose.

A historical and educational exhibit will be arranged under the direct auspices of the Exhibition Committee. In addition to this there will be exhibits by the manufacturers of the various commercial types of electric and gas lamps, accessories and fixtures.

The exhibition will be especially valuable as containing a number of the latest developments in the production and utilization of light which have not been heretofore publicly exhibited in this country.

The building will be open to the public from 8.30 a.m. till 11 p.m.

The time and place of meeting this year will afford opportunities for the study and observation of decorative and spectacular lighting which have never before been equaled in this country, and will probably not be surpassed, if indeed they are equaled, for years to come. If the illumination of a score of blocks on Broadway is worth coming to see, what can be said of the illumination of not only New York harbor, but of the whole Hudson River throughout its navigable course? Another unique feature, which would be absolutely impossible in any other metropolis in the world, will be the parade of half a hundred modern battleships past the city and up the river which was first sailed by the cockleshell called the *Half Moon*.

The historical street parade, representing all the nations of the earth, will take place on Tuesday, and without doubt will be the most elaborate and imposing pageant of the kind ever organized. Excellent facilities for reviewing this instructive and inspiring spectacle will be given to members of the society and their guests in attendance at the convention.

The sessions of the convention have been so arranged as to conflict as little as possible with the principal events of the Hudson-Fulton celebration. The sessions, as well as the reception on Monday evening, will take place during the time that purely local and special features of the celebration are being caried out.

Although the Hudson-Fulton celebration will undoubtedly prove to be the most magnificent historical festivity that has ever taken place in this or any other country, the members of the society and others interested in the subject of illuminating engineering should not lose sight of the fact that the convention itself will be of special interest, and of lasting benefit to those who participate. The continued growth of the society and of illuminating engineering will be fully represented in the character of the papers presented, a majority of which will set forth the results of original research and investigation.

It is intended to have the discussion of the papers form the most important part of the proceedings. To this end all papers will be presented in abstract, leaving the larger part of the time for discussion.

No one intending to come to the convention should fail to be present at the opening session, Monday afternoon. Besides the opening addresses, there will be two committee reports, one of which is of particular interest to the members. This is the report of the Committee on the Division of Membership, which was appointed at the last annual meeting to formulate a method of classifying members of the society into such as are qualified to take the title of Illuminating Engineer and those who are learners or interested in the general objects of the society.

Most urgent warning is given to those who intend to come to secure their hotel accommodations at the earliest possible

date. The hotel capacity of the city is barely sufficient to meet the normal conditions at this season of the year, and with the enormous influx of visitors to the Hudson-Fulton celebration their available means of accommodation will be taxed to the utmost. Those desiring reservations should address Mr. A. J. Marshall, 227 Fulton street, New York City.

Modern Construction in Lampposts

We Americans have been prodigal users of wood. When one is in a hurry it is quite natural that he should seize upon the materials closest at hand for whatever he has to do. The use of wood in the pioneer days accomplished a double purpose: it disposed of the chief encumbrance of the soil, and furnished a material which lent itself readily to primitive methods and facilities of construction. With a few simple hand tools, the ingenious Yankee could build a dam and erect a saw mill, with no other use of iron than for the saw itself.

The wooden age in America, however, is rapidly passing. The land has long since been cleared of its encumbering forests, and progress in science and the arts has developed, and thereby created a demand for more substantial and enduring material. The alarm over the rapidly diminishing supply of timber is perhaps no better founded than was the alarm felt a couple of generations ago over the imminent extinction of the sperm whale. With this source of oil gone, from what was light to be obtained? Steel, concrete and clay products are supplying the place which wood occupied a half century ago, and in a manner as far superior as the modern electric light is superior to the old whale oil lamp.

Wooden construction is of necessity unsubstantial and temporary, and inevitably carries the idea of either a makeshift or of a lack of means sufficient to procure more enduring and modern materials. The wooden lamp post for electric street lighting was to be expected in the early stages of the art; but both electric lighting and municipal wealth have outgrown these primitive methods.

The movement for better street lighting, which has made such rapid headway during the past two years, has generally involved the use of not only the more substantial iron construction for lamp posts, but has taken account of the artistic appearance as well. There are still a few cases, however, in which wooden posts have been erected. This is undoubtedly false economy from every point of view; while such posts will naturally be somewhat cheaper than those of concrete or metal construction, they are of necessity less durable, thus making them more expensive in the end, besides giving the inevitable stamp of cheapness and makeshift appearance.

One of the chief objects in the newer lighting installations is to advertise the city; and it is a notoriously poor policy to send out an advertising agent cheaply dressed. Brilliant illumination will invariably produce a favorable impression, but it should be remembered that the lamps do not burn by day, and that the only advertising value during daylight hours is confined to the posts themselves. If these are of a cheap and flimsy construction they suggest a desire to shine with paste diamonds.

Modern light sources are worthy of modern lamp posts; and the modern lamp post is of metal or concrete construction.

The Illumination of the Singer Tower

The article on this subject published in our last issue has brought forth a most interesting bit of illuminating engineering history, which will be found in the correspondence department in this number.

To draw a practical lesson in spectacular lighting from the illumination produced by a burning building is a striking example of the peculiar but leading characteristic of the inventive mind; for invention and discovery consist in nothing more than the application of familiar phenomena and devices to new and original uses.

The fact that efforts have been made to adequately illuminate the Statue of Liberty, which graces our magnificent harbor by day and disgraces it by night, is also both interesting and instructive—interesting as suggesting the spectacle that the statue would produce if illuminat-

ed on the line of the Singer Tower, and suggestive as showing the absolute superiority of private enterprise and initiative over government lassitude in matters of public improvement.

The possibilities of the searchlight in exterior spectacular lighting may be fairly well conceived by a consideration of the part played by the " spot light," which is simply a searchlight arranged for interior use, in theatrical productions. Mr. Armstrong's appreciation of this fact is another evidence of his inventive genius.

An example of what can be accomplished by this Leviathan of modern light sources will be afforded in the special illumination during the coming Hudson-Fulton celebration, which will make a larger use of the searchlight than has ever before been attempted. In the words of the showman, this scene alone will be worth the price of admission. If any further proof is needed of the grandeur and beauty of the effect that will be thus produced, it will be found in the statement that this phase of the spectacular illumination is in charge of Mr. W. D. A. Ryan, whose experience and familiarity with the searchlight, and whose originality and boldness of conception of spectacular lighting effects, undoubtedly surpasses that of any other American illuminating engineer, if in fact it is equalled in the world.

If you fail to " take in " the Illuminating Engineering Society convention and the unparalleled opportunities for the practical study of illumination, you will miss half of your life.

Improvement in Illumination and Improvement in Light Sources

The most important single step in the direction of the better use of artificial light was a result of the commercial introduction of the enclosed arc lamp. Its predecessor, the open arc, was generally used without any means of diffusion, and its blinding glare no doubt led many, if not the majority of users, to greatly overestimate its real illuminating power. The enclosed arc took care of the matter of diffusion itself. If clear enclosing globes were used they soon became coated with a deposit of ash, which gave practically the same diffusion as frosted glass. Partly to hide this deposit and partly to make the apparent source of light appear larger, opalescent enclosing globes were generally used. The arc itself being thus entirely hidden from the observer, the claim was made that the vapors themselves became incandescent, and the term " incandescent arc " was quite generally applied for some little time after its introduction. The larger apparent source and the much better illumination produced on account of the removal of the glare of the open arc rendered it easy to persaude the user that the lamp was actually giving more light than the older form. This is the most conspicuous case on record where a light-unit giving better illumination, *i. e.,* an illumination which enabled the eye to see better, was cheerfully accepted for a source of considerably higher efficiency in the actual production of light.

The same advantage which proved so effective in the introduction of the incandescent, or glow lamp, and which will always prove effective with Americans, namely, greater convenience and less care, gave the enclosed arc the lead over the more efficient type which it displaced. Probably the most valuable thing which the enclosed arc lamp accomplished, however, was its practical demonstration of the importance and value of diffusion, and in bringing out the basic fact of illuminating engineering—that the proper ultilization of light is quite as important as its proper production.

In view of the lesson taught by the enclosed arc, it is interesting to inquire what lesson in illuminating engineering, if any, is to be found in the recent revolutionary improvements in the production of electric light. What, for example, has the tungsten lamp done in the way of bringing about a better use of light?

We may observe first that it seems destined to repeat for incandescent electric lighting the lesson that the enclosed arc taught in arc lighting, namely, the importance of diffusion. Both its larger total candle power and greater intrinsic briliancy have worked toward this end. When the 50 or 100 c. p. tungsten, with its dazling intensity of filament, was put up the change was sufficiently apparent, and the lesson of the enclosed arc well enough learned to cause a general demand

for diffusion. Illuminating engineering, however, was sufficiently advanced to show how to secure this necessary quality of illumination with a minimum of loss in efficiency. As a result, the tungsten lamp has rarely been installed in its naked state, but in conjunction with a globe or shade carefully designed to remove the intolerable glare, and at the same time give the most advantageous distribution of its light. The tungsten lamp has demonstrated the necessity of considering a light source as an element of a lighting unit rather than a finished product in itself.

Undoubtedly also it has shown the advisability of the use of a greater total quantity of light for many commercial purposes. In other words, the tungsten lamp has raised the general standard of illumination. It is safe to say that no single improvement in light production has been more instrumental in the improvement of illumination, and what is the same thing, the furtherance of illuminating engineering, then the tungsten lamp. While these results must have followed in any case, the progressiveness and wisdom of the manufacturers have enormously accelerated the acceptance of these advantages on the part of the public.

Beside the purely practical improvements thus brought about, the tungsten lamp and its sponsors are responsible for a decided start toward a more just appreciation of the aesthetic side of illumination. The tungsten lighting unit has, without exception, had some claims to artistic merit; at least it never displayed the aggressive ugliness that was so often in evidence with the old carbon lamp. In this respect also the tungsten lamp has repeated the history of the enclosed arc lamp, which was far more sightly than the old open arc. The tungsten lamp is, therefore, quite as revolutionary in its effect upon illuminating engineering as in the mere scientific property of efficiency.

And what of the flaming arc lamp? What does its remarkably rapid introduction in this country signify as to improvement in illumination? Undoubtedly its first effect is along the same line, namely, of showing the value of diffusion. Though giving seven or eight times as much light as the familiar carbon arc, the flaming arc is practically free from glare. By its enormously larger flux of light, as well as its higher efficiency, in both of which respects it almost exactly corresponds to the improvement of the tungsten over the carbon filament lamp, the flaming arc has likewise raised the standard of exterior illumination.

This is of much greater importance than the corresponding effect in interior illumination. Comparatively speaking, our streets and public squares, at least until very recently, have been as dark as our homes were before the days of gas and electricity. The flaming arc showed a new standard for outdoor lighting; and whether its half-brother, the luminous or metallic arc, is to finally usurp its place or not, the lesson which it has taught will never be forgotten. There will be no backward step in exterior lighting, but a constant onward march toward a degree of illumination corresponding to that now generally demanded for interior lighting.

Notes and Comments

Philadelphia Spectacular Lighting Scheme Gets a Jolt

TRACTION COMPANY WAKES UP AND DISCOVERS THAT LAMPPOSTS BETWEEN TRACKS WOULD BE DANGEROUS—AND EXPENSIVE TO THE COMPANY.

Ever since the installation of the memorial lampposts around its memorable City Hall, nearly a year ago, Philadelphians have been agog over the question of spectacular street lighting. A plan for lighting Broad and Market streets—the only streets in the business center wide enough for ox teams to pass without bumping the trolley cars—was devised by the city electrician, which involved the placing of ornamental posts between the car tracks on Market street, to carry the trolley wires and support arc lamps. The plan was widely discussed in the daily papers, and apparently met with general approval. On the eve of its being carried into effect the Traction Company

officers, who apparently had just heard of it, rubbed their eyes open and concluded that the scheme wouldn't do: it would be dangerous to their patrons; people reaching out of the car windows to shake hands with their friends in a passing car would resent having their greetings broken off by contact with the lampposts. As the only way to avoid this contingency would be to relay the tracks farther apart, at the cost of some hundred thousand of dollars, they put the snuffer on the hopes of expectant Philadelphians.

As soon as he regained his mental equilibrium from this sudden throw-down, the city electrician came forward with a plan for placing arches over the street at intervals of about 125 ft.; the arches to be supported by decorative iron columns placed along the curb, and to have arc lamps suspended from the center, with a string of incandescents marking the arch on either side. By way of compensation, the supporting columns were to be equipped with mail boxes, fire alarm boxes and drinking fountains. What kind of drinks were to be supplied was not stated. Even public telephones were suggested, thus enabling the citizen to telephone down a couple of blocks and find out if a car was coming. The only thing omitted —and we must allow something for the hasty preparation of the plans—was a roof garden on top of each post, lighted with a singing arc.

From latest press reports, however, it appears that our Friends may have to forego these public conveniences. The city electrician, on second thought, is reported as turning down the arch scheme as impractical, stating that it would give the street the appearance of having an elevated railroad on it. He is quite right. As a permanent street lighting installation, the arch has very little claim to consideration, and especially on a street as wide as Market street, Philadelphia. Besides cluttering up the sidewalk with the supporting columns, and obstructing the view with unsightly overhead construction by day, such a system converts the street into a long, low, covered passageway by night when the lamps are lighted. The avoidance of such a mistake at the cost of a hundred thousand dollars would indeed be cheap; and Philadelphians will do well to uphold the stand taken by their city electrician, whose original plans possess undoubted merit, and are sure to be a source of pride to the citizens if they are carried into effect.

Let There Be Light, and Let It Be Cheap

CHICAGO GOES THE DIVINE FIAT ONE BETTER.

Chicago is the proud possessor of an electric lighting plant, which has the unique distinction of being driven by its sewage. Just what kind of water wheels have been constructed to let through Chicago sewage is not strictly pertinent to the present question. The fact remains that the electric plant is in successful use for lighting Chicago's streets; all of which is fully set forth in the twelfth annual report of the department of electricity, which is headed by Mr. William Carroll.

It is claimed that the municipal lighting saves the city $72,000 a year. It is to be hoped that the saving will be expended in giving the streets still better illumination, and if the *American's* advice is taken this will be done:

The advantages of a city brilliantly lighted are overwhelming. Least of all is the artistic effect, the impression made on visitors or sojourners in the city, who are at once impressed by the splendor of a system that turns night into day and sheds a searchlight that is never absent.

The ugly spots of a city that are so kindly hidden by the coming on of darkness are as ruthlessly exposed under the strong electric light as in the full glare of the sun. The continued protrusion of these plague spots gives the citizen no time to forget municipal negligence or indifference, and exhibits remorselessly the eyesores that should be removed or remedied.

Jersey City Merchants Want a Great White Way

THE PROJECT IS TAKEN TO THE MAYOR.

With New York and its original Great White Way on one side and Newark and its brand new installation of flaming arcs on the other, Jersey City is for the time quite eclipsed. The instinct of self-defence, if nothing else, would lead its business men to activity looking toward better public lighting. Jersey City is simply following the course taken by so many other cities, in which the progressive busi-

ness men have co-operated, both morally and financially, in the movement for better street lighting. That the outcome will be the same is a foregone conclusion. Jersey City can no more afford to leave its business streets in comparative darkness than can any other town; less so in fact, on account of its proximity to the two other cities mentioned.

Fifth Avenue to Celebrate the Beginning of Its New Life By a Baptism of Light

BUSINESS MEN OF THE STREET WILL ATTEMPT TO MAKE IT THE MOST CONSPICUOUS FEATURE DURING THE HUDSON-FULTON CELEBRATION.

With the clearing of the sidewalks of obstructing doorsteps, and the widening of the roadway through its most traveled part, which is expected to be finished in time for the Hudson-Fulton Celebration, the Fifth Avenue Association, representing the progressive interests of the thoroughfare, are planning to mark the event with an impressive lighting spectacle. If the spectacle is as brilliant as the rhetoric of the writer in the New York *Herald* it will indeed do justice to the street, which is one of the two best known thoroughfares on the western continent:

Fifth avenue will be ablaze with color day and night during the two weeks of festivity. And, unless the plans of its most prominent merchants, patrons, adjacent residents and the deeply interested public in general miscarry most sadly, the finish of the Hudson-Fulton celebration will but mark the continued illumination of Fifth avenue in memory of Hendrick Hudson, Robert Fulton and the splendid celebration in their honor which awakened Fifth avenue to a realizing sense of the importance to its property owners, merchants and others of displaying its wealth of art treasures, silks, satins, draperies and jewels to the public view by night as well as by day.

Drawn shutters and gloomy surroundings do not attract, but repel. Fifth avenue must cast aside its self chosen shroud now and forever and become and remain one of the most elaborately illuminated thoroughfares in the world, not only during the period to be devoted to the Hudson-Fulton Celebration, but ever after, until the Empire City has ceased to be and until foreign callers have ceased to knock at the open door of the city.

Clippings

Although the United States military posts in the Philippines have long been lighted by electricity, similar posts nearer home are still in the semi-darkness of kerosene. Now Fort Hamilton, also, is to be rescued from Standard Oil clutches. The Government has just given an order to the Brooklyn Edison Electric Illuminating Company to furnish current for 2000 lamps of powers to be hereafter specified. These are to light officers' houses, barracks, hospital and streets of the reservation.—*Brooklyn Citizen.*

There is no doubt about the proposition [for a new street lighting installation] going through. All that is to be decided is the most feasible and needed place for the process of illumination to be started. Once started, Secretary Walter B. Moore, who has nurtured the project since its incipiency, feels confident that it will spread until the whole of the business section of Dayton is beautified and improved with the lighting system. The action is not only countenanced, but encouraged by public-spirited citizens.—*Dayton (O.) Herald.*

Property owners in East Front and Boardman streets call attention to the lack of street lighting. In the Bowery in New York City crime was practically abolished by street lights. It is claimed by well versed men that at least ten additional street lamps should be installed in East Front street alone.—*Youngstown (O.) Indicator.*

The lights are now being installed on the Seventh Street Bridge and will be turned on for the first time to-night. The roadway on the bridge will be illuminated with flaming arc lamps, the total illumination being 20,000 cp. Manager Harry Davis of the Forbes Field Hippodrome has arranged to install 50 arc lamps for lighting the spacious grand stand and 125,000 cp. from flaming arc lamps to light the arena.—*Pittsburgh Dispatch.*

The Tokio, Japan, Electric Light Company supplies (April 30) 86,078 families with 368,627 electric lights, and 1451 houses or concerns with 5294 hp. in electric power. Out of 1,844,331 yen ($922,165) in the last half year the company made a working profit of 1,153,124 yen ($576,562).—*New York Sun.*

E. H. Stewart and George Barnhart, O., R. & N. engineers, and G. E. Foster, an engineer on the Northern Pacific, testified today before the railroad commission in favor of electric headlights over acetylene. The electric headlight, in the opinion of the engineers, is the only light to be considered.—*Spokane (Wash.) Spokesmen-Key.*

Correspondence

Electric Illumination Topics in Great Britain

By James A. Seager.

(Special Correspondent.)

The pacific invasion of Great Britain by America is exemplified by the colossal store which Mr. Selfridge opened some four months ago at the western end of Oxford street, London. The frontage of the block, consisting of four floors above ground and two below, reaches from Duke street on the east towards Orchard street on the west. The architects were Mr. R. Frank Atkinson, F.R.I.B.A., of London, and Mr. D. H. Burnham & Co., of Chicago. The premises are lighted by means of arc lamps, three hundred and five lamps in all being specified, seventy-seven of 7.5 amperes, two hundred and twenty-three of 6 amperes, five of 5 amperes and nineteen spares. These lamps are all of the enclosed differential type. They have one shunt and one series coil, with self-contained resistances, and are suited for burning two in series on 240 volts direct current. All lamps burn very steadily for 60 to 65 hours without recarboning, am-

FIG. 1.—ILLUMINATION, SELFRIDGE & CO.'S NEW DEPARTMENT STORE, LONDON.

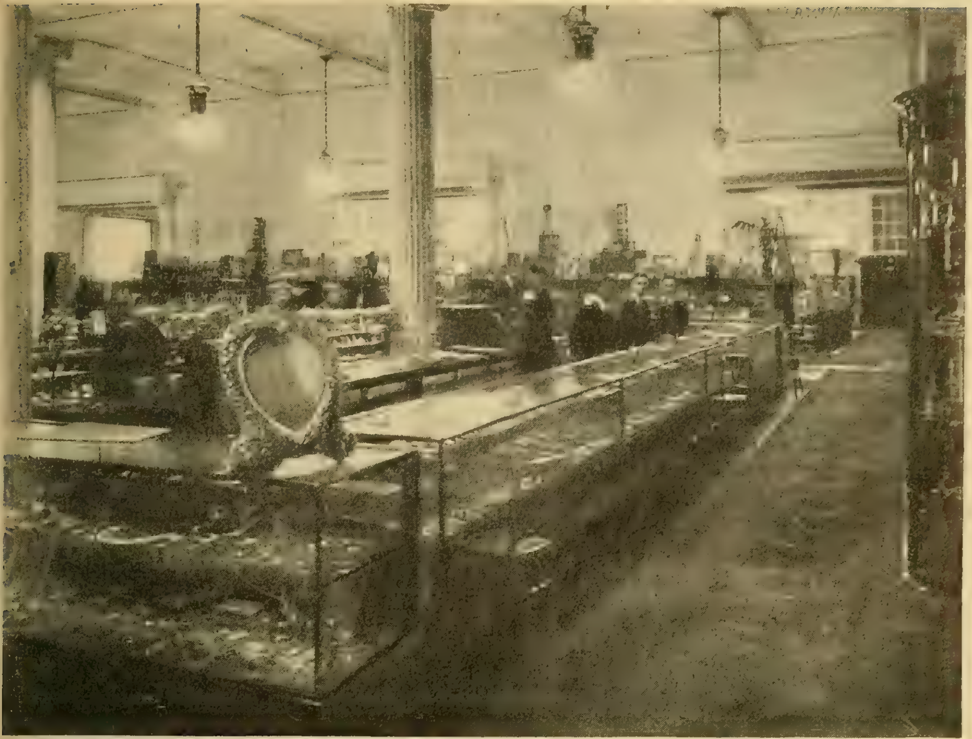


FIG. 2.—ANOTHER VIEW, SELFRIDGE & CO.'S NEW STORE, LONDON.

ple ventilation being provided. Sixty-seven are of the single enclosed class, with conical covers finished in white enamel and having pine shaped opal globes. The 7.5 ampere lamps of this class are fitted with carbons of 13 m/m and the 6-ampere with carbons of 12 m/m diameter. Two hundred and thirty-eight are of the double enclosed class, having ornamental cases of Corinthian pillar design finished in black and silver and fitted with clear glass inner globes and special opal outers designed to ensure special diffusion of light. These lamps are fitted with carbons of 13, 12 and 11 m/m diameter, respectively, according to amperage.

During the present brilliant summer weather the subject of artificial illumination is not a particularly absorbing one, and the photographing of artificial illuminants by daylight is distinctly to be deprecated. Perhaps, however, the accompanying illustrations, Figs. 1 and 2, secured under these conditions, may afford some idea of the style and method of distribution of the lamps as seen at 8.30 o'clock a.m., before the rush hours at Selfridge's have set in. They are certainly interesting as illustrating one of the finest examples of electric store lighting to be found in Great Britain.

A very interesting application of electric illumination has just been developed in connection with motor car work by C. A. Vandervell & Co., of London. The great trouble has hitherto been that a battery of sufficient capacity to supply powerful headlights is heavy, bulky, expensive and requires a long charge necessitating a long stop at a garage. The problem of providing a permanent source of electricity on the car, doing away with excessive storage, has been met by the application of the "Leitner" system of electric train lighting to motor car work. It is no part of this article to enter into engineering details, but it may be briefly stated that the Leitner patent variable speed dynamo driven from the clutch shaft or cardan is capable of provid-

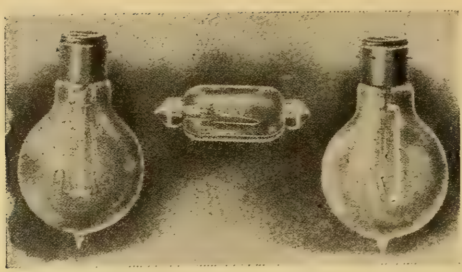


FIG. 3.—NEW METAL FILAMENT LAMPS FOR TRAIN LIGHTING.

ing current at an even voltage with a very wide range of speed by means of two subsidiary brushes between which and the main brushes, the field windings are suitably connected. A practical speed range of 1 to 6 (580 r.p.m. to 3500 r.p.m.) can be obtained by a dynamo working in conjunction with an 8-volt battery, giving a mean output of 6 amperes. An automatic switch automatically connects or disconnects the battery to or from the dynamo at approximately 580 r.p.m., according to the condition of the battery and the rise or fall of the speed. Fig. 3 shows the type of metal filament lamp, ranging in candle power from 3 to 30 and running on 4 to 12 volts, specially designed to focus correctly in the headlight. The Leitner equipment generally similar to that above described has been fitted to one of the omnibuses of the London General Omnibus Company, a current of 6 amperes being given to the headlights, destination indicator, interior lamps and ignition, at a pressure of 10 volts.

In connection with the great summer show called the White City with which London amuses itself, Messrs. Simplex Conduits, Ltd., have been endeavoring to combine instruction with amusement by equipping an electrical hose. In this is displayed more particularly the applica-

FIG. 4.—BEDROOM, ELECTRIC HOUSE, WHITE CITY, LONDON.

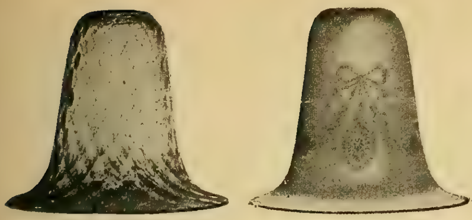


FIG. 5.—NEW GLASSWARE FOR METAL FILAMENT LAMPS.

tion of electricity for domestic purposes, such as heating, cooking and lighting. The building is divided into five rooms, comprising a large showroom in which visitors may examine the various classes of electrical apparatus, dining room, drawing room, bedroom and kitchen. In the bedroom, shown in Fig. 4, special mention may be made of a new design in hand glass mirrors. These are provided with a special lens behind which is fixed an 8 candle power electric lamp. A brilliant light may therefore be concentrated on any part of the face at will.

Mention was made last month of the very rapid progress which metallic filament lamps are making in Great Britain, and two or three indications of this advance may be mentioned. The first is that makers of glassware are now bringing out special lines of shades suitable for the new types of high voltage, high efficiency lamps with long bulbs. For example, Messrs. Siemens Dynamo Works, Ltd., have specially designed a complete line of such shades, so constructed that the end of the lamp only is shown. Most of the shades are designed so as to soften the brilliancy of the high voltage lamps and the light is thus rendered most diffused and pleasant. As examples of these shades are shown a molded flint opalescent globe giving a very good effect, and a satin etched decorative shade in the Adams style (Fig. 5).

A second indication is the various devices adopted for metallic filament cluster lighting. One of these, introduced into England by G. Braulik, is of considerable interest, as it combines clustering with semi-direct, semi-indirect lighting. In the type of fitting shown in Fig. 6 two to seven lamps can be combined

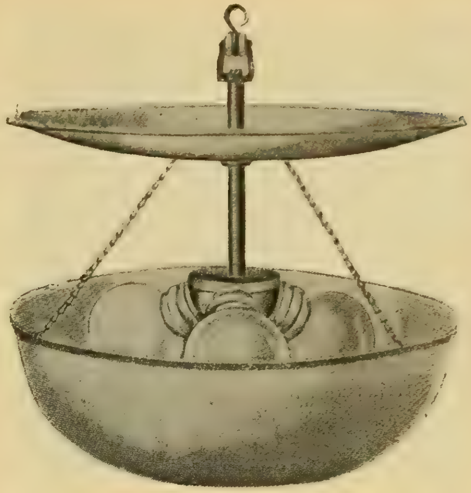


FIG. 6.—SEMI-DIRECT AND SEMI-INDIRECT LIGHTING UNIT.

in twenty-four different switchings, which result seems rather in advance of other systems. The object of the arrangement is to replace the arc lamp for interior lighting, uniting the advantages of the arc with a steady light, shielded so as to be non-injurious to the eyes. For low white ceilings in proximity to the clusters the reflector is dispensed with, and Fig. 7 shows the distribution of light from five tantalum lamps of 50 h. k. each, the mean spherical candle power being 310 h. k. For rooms where the ceiling is dark or removed from

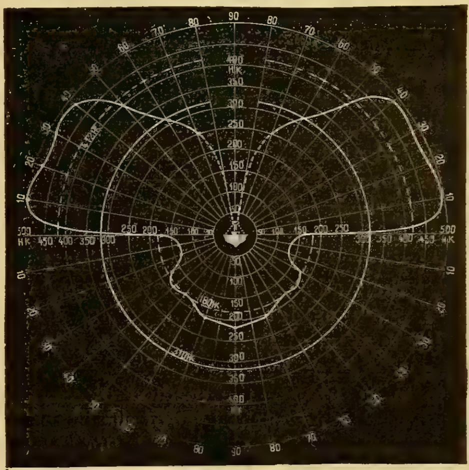


FIG. 7.—DISTRIBUTION CURVE OF INDIRECT LIGHTING UNIT.

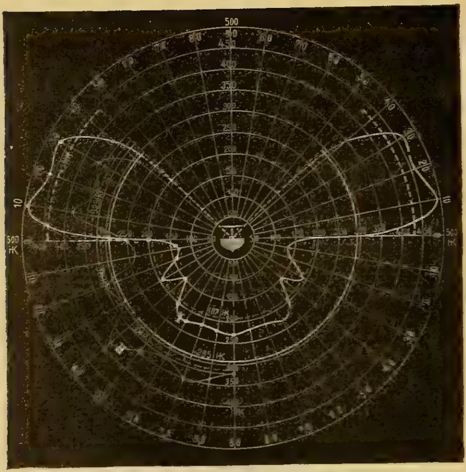


FIG. 8.—DISTRIBUTION CURVE OF SEMI-DIRECT AND SEMI-INDIRECT LIGHTING UNIT.

the source of illumination a reflector of 500 m/m. is added· as shown in the illustration of the cluster, and Fig. 8 shows the illumination from the same lamp cluster with the shade. The curve marked I. shows the light distribution from the complete cluster, while curve II. gives the distribution of light due to the same lighting cluster without the glass shade fixed beneath the lamps. It will be seen that very little light is lost in absorption through this shade, its function being a more thorough diffusion of the light intensity. It will, of course, be apparent that the cost of the current consumed by such clusters is considerably less than that taken by arc lamps of a similar candle power.

Yet a third symptom of the spread of metallic filament lighting is found in a patented form of lantern produced by Messrs. Drake & Gorham, Ltd., of Westminster, which includes a system of ventilation adopted to prevent blackening of lamp bulbs which so seriously militates against their adoption in out-of-doors positions, such as for street lighting and the illumination of railway stations, store windows or large buildings. The lantern is shown in Fig. 9, the method of ventilation consisting in the heat of the lamps inducing a current of air through the hole in the bottom of the globe, through a perforated disc and out through small holes at the top, covered with an ornamental bonnet to keep them waterproof. This ventilation keeps the lamps comparatively cool, even when very high candle power is used, with the result that in the largest size made, having a diameter of globe of 15 in., for 100 c. p. lamps can be clustered. If bulbs of this power were enclosed under a globe without ventilation they would become black in a week. The disc which holds the lamps in a vertical position acts as a reflector, and in conjunction with the opal part of the globe gives a very fine distribution of light.

From the report for the year 1908 of the work of the National Physical Laboratory, which is now to hand, it will be found that in addition to the international comparisons of light standards to which reference was made in this letter of last month, a large number of comparisons have been made throughout the year between the National Physical Laboratory standard pentane lamp and the primary electric standards of the laboratory. An accuracy of one part in 1000 is aimed at in interpreting the value of the unit in the various electric standards, which have been or are being made at the laboratory. In connection with this, work has been done in the establishment of two new sets of standard lamps of whiter light than those used for electric sub-standards.

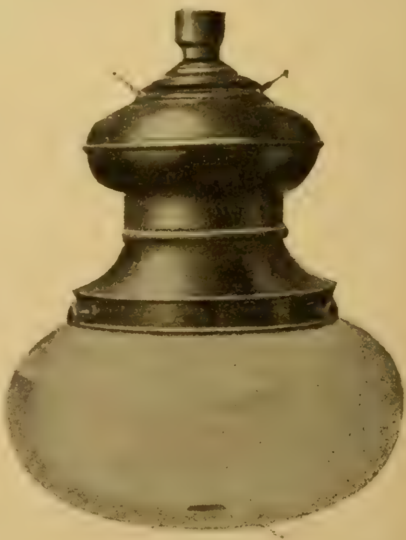


FIG. 9.—NEW TYPE LANTERN FOR OUTDOOR LIGHTING, WITH METAL FILAMENT LAMPS.

These run at 3.5 and 3.1 watts per candle respectively, and efforts are being made to obtain further sets down to 2 and 1.5 watts per candle. These will be exceedingly useful as reliable standards for the photometry of metallic filament lamps. To meet the extended use of high power lamps a new 4½ metre photometer bench has been installed in the Photometric Standards section, and for the purpose of systematizing the life tests of glow lamps to the Engineering Standards Committee specification a new equipment of three life test frames, each accommodating 100 lamps in ten separate racks, has been constructed. Each frame can be tilted so that the lamps in it may be burned at any desired angle, and each frame is fed by a separate auto-transformer excited off an automatically regulated 240 volt supply.

An article by Mr. Launcelot W. Wild, in *The Electrician* for July 16, is attracting considerable attention. He points out that the flicker photometer gives the same reading within 1 per cent. again and again, even if the lights tested differ in color to a considerable extent, but that it cannot be said to show equalities of illumination. It credits a tungsten filament lamp with about 6 per cent. too little candle power when compared with a carbon lamp.

A test was made on a Sunbeam tungsten lamp of 1.5 watts per candle power against a carbon lamp of 4.5 watts per candle power by the double balance method. The results obtained were as follows:

	Flickers.			Contrast.	Equality.	
	Wild.	Whitman.	Simmance.	Bunsen.	Prism.	Lummer.
Max. reading	1.73	1.735	1.735	1.86	2.05	2.00
Min. reading	1.72	1.715	1.71	1.79	1.72	1.70
Mean reading	1.725	1.725	1.72	1.825	1.85	1.83

It is seen that the readings on the Bunsen, prism and Lummer photometers agree closely on the means, but these are 6 per cent. greater than the results obtained with the flickers. The deductions that Mr. Wild makes are that (1) for testing tungsten lamps against carbon lamps, a flicker head must not be used; (2) equality of brightness photometers fail on the score of insenitiveness; and (3) contrast photometers of the Bunsen type alone fulfill the required conditions, although it is a pity that the sensitiveness of the flicker type cannot be secured.

From Our Readers

[We published in our last issue a description of the exterior lighting of the Singer Tower. The data and photographs for this article were furnished us by a source wholly unconnected with the Singer Mfg. Company, as well as the engineers who designed the lighting installation. As a result no personal mention was made in connection with this remarkable and magnificent piece of spectacular lighting. Since the publication of the article we learned that the original conception of the idea was due to the consulting electrical engineer of the building, Mr. Charles G. Armstrong. We accordingly requested Mr. Armstrong to give us a history of the case and received the following very interesting reply. Ed.]

EDITOR THE ILLUMINATING ENGINEER:

Dear Sir: Replying to your letter of the 16th inst., I will state that the history of the lighting of the Singer Building dates back a good many years.

My first conception of this method of illumination came about through a fire in Chicago, which beautifully lighted up an adjacent building, giving me an idea of what a wholesale reflected lighting proposition would do to bring out the architectual features of a building. It has also been my pleasure to have had the opportunity of designing the lighting plants for a good many theaters, where I got the impression of a spot light effect in bringing out a given object, and have waited a good many years for an opportunity to put this scheme of lighting into effect.

The first example of an object that needed lighting of this character was the Goddess of Liberty, and I have long sought an opportunity of lighting this statue in the proper manner; but unfortunately the Gods of War are not interested in refinements, their total education being to destroy. Beauty has no part in their make-up, and propositions for beautifying New York Harbor falls on deaf ears.

The first client that I found willing to listen to a scheme of this kind was the Singer Mfg. Company. Here was a

building of most difficult coloring, raising its head far above all others on lower Manhattan, that could be easily made a center of attraction, but, like the Goddess of Liberty, would not be visible after night. A great many plans were suggested for lighting this building; flaming arcs in the top, outlining the building a la Coney Island, with much discussion as to the practicability of this or that scheme. The writer held fast to his original idea, notwithstanding that there was so much discussion opposing the searchlight scheme which I devised. However, specifications were issued from my office calling for propositions on lighting the outside of the tower with searchlights.

After issuing these specifications the General Electric Company was invited to make a proposition. Mr. W. D'A. Ryan was detailed on the job by them and a series of experiments were tried under my supervision at the works of the General Electric Company at Schenectady, at which time it developed that a large number of small units would be the proper method of accomplishing the end sought. Mr. Ryan at this stage of the proceedings gave most valuable assistance in calculating the amount of flux required and the number of lamps. My first idea was to place the lamps as they are now placed, throwing the light directly on the building, but owing to the supposed difficulty of breaking mirrors from falling particles of red hot carbon, I suggested that the lamps throw their beams horizontally, and that mirrors be placed around the building, giving the light the proper angle to throw it against the building. This, however, proved to be too expensive on account of the cost of mirrors, and some practical experiments conducted by the General Electric Company demonstrated that the danger of breaking the mirrors was imaginary and not a real one, principally owing to the fact that Mr. Ryan introduced gauze baskets directly beneath the arc in such a way as not to materially obstruct the rays, and yet to catch any particles of carbon that might fall.

One of the most serious problems we had to contend with was the placing of the lamps a sufficient distance from the tower in order to get the distribution of the light over the surface of the building. This was worked out with great pains by Mr. Ryan. We found that after placing the lamps on the spots originally calculated that it was necessary to entirely rearrange them, and many months were spent in adjusting and arranging these lamps, this work being done partly by the General Electric Company, partly by the contractors, the M. B. Foster Electric Company and by the engineering force of the Singer Mfg. Company under my direction.

One of the difficult features of this installation was the lighting of the curved surfaces above the thirty-fifth floor, which surfaces could not be reached, except by the searchlights down below. This problem I solved by using half-shade reflectors of aluminum, so that the lamps themselves would not be visible, strictly adhering to the first principle of illuminating the building by reflected light. In connection with this we found that the omission of even one reflector obscured a large section of the building, on the principle of the old so-called Luxifer used in state lighting, which consisted of throwing a glare of light around the proscenium arch into the eyes of the audience, thereby making the stage practically invisible. An alluring proposition of flaming arcs placed on the top of the tower was made at this time by different contractors, all of them overlooking the above fact.

The results of our labors speak for themselves, and the able article in the August number of your magazine tells better than I can the effectiveness of this method of illumination.

I wish the readers of this magazine to know that credit for this lighting is due first and all the time to the officers of the Singer Mfg. Company, who adopted my plan, and second to Mr. W. D. A. Ryan, whose untiring energy and zeal very materially aided in the execution of this work.

Yours very truly,

CHARLES G. ARMSTRONG.

CASHIER BOOKKEEPER CONTRACTS ADVERTISING

Commercial Engineering of Illumination

Lighting Company Securities as Investments

The question of investment probably has a greater influence upon the commercial activities of a country than any other single agency. The sweeping and disastrous panic can always be traced to unwise investment. Confidence feeds upon itself, and waxes fat upon its food: a judicious or lucky investment of a dollar leads to the less cautious investment of two more dollars; and the unwise or unlucky investment of the two dollars causes the investment of three more dollars on mere dreams and hopes based upon nothing more substantial than the wish to make good the previous investments. If the last three dollars are borrowed, as is likely to be the case after a sufficient period of luck and prosperity, and the dreams fail to materialize, as is sure to happen sooner or later, then the wiping out of the entire six dollar investment is inevitable, and that means financial panic.

Were money never invested except upon careful investigation and deliberate judgment of the facts, and then only such as could be taken from accumulated surplus, we should never know the stress and strain, and lingering misery incident to the financial panic. With the recent experience still fresh in our minds we should be in a receptive mood to consider the subject of investment with due regard to facts and principles.

The corporation, as Lawson so clearly pointed out in his dramatic work on finance, is the modern invention for collecting the surplus earnings of the people and using their combined power in productive enterprise; and, as he also points out, the invention is a theoretically perfect device for accomplishing this beneficient purpose. That the results are sometimes quite the contrary is not the fault of the instrument, but of those using it. The question of investment at the present day, therefore, simmers down to a matter of the purpose and management of the corporation. An attempt to analyze the general problem and apply the principles to the particular class of corporations which are engaged in furnishing light, or the means wherewith to produce it, to the public, may not be without interest.

The first and most obvious fact in regard to the corporation is its public, or quasi-public, origin and nature; it is a creation of the State and amenable to its creator for the general conduct of its affairs. Furthermore, it is under the more or less direct management of several individuals, so that the risk of personal dishonesty, which proved fatal in so many cases of the old time co-partnership, is practically eliminated. Obviously there will be the least tempeation to premeditated dishonesty, or to take unwarranted chances, where there is the greatest amount of public surveillance. The safest investment in the world is the security issued by the people's own corporation, commonly known as the government; and this safety is due to no other cause than that every citizen is a natural monitor of the conduct of those who manage their corporate interests. The more conspicuously the affairs of a corporation are in the public eye, the less the chances of dishonesty and mismanagement, and the greater the safety of its securities as an

investment. This supplies the greatest factor of safety in lighting company securities. Both in the nature of its product, and in the conditions under which it operates, a lighting company is brought into continuous and conspicuous contact with the public. Light is not only a commodity of universal use, but is an item of no small consequence in the general expense account of living.

The fact that in recent years lighting companies have often been targets for the random firing of political agitators and demagogues, together with a few well-meaning legislators, should be considered rather for than against the stability of their securities as investments. The fear of hostile legislation, as well as its enactment, is a powerful restraining influence against reckless or fraudulent corporate management. On the other hand, the highest courts of the land have repeatedly shown in their decisions that, while lighting companies are no more exempt from the enaction of reasonable laws looking to their regulation than are saving banks, insurance companies and other public institutions, such regulation will never be permitted to become confiscatory nor jeopardize their possibilities of earning reasonable profits. Thus, between the bulwark of the courts and the vigilance of the politicians and the people, the course of the lighting corporation would seem to be as safely confined and directed as is possible in human affairs.

With this double assurance of honest and efficient management the nature of the business with reference to its probable earnings and expansion may next be considered. On this point the record of the past will furnish invaluable data for judging the future. The normal increase of the electric lighting industry for the past quarter of a century has been about 20 per cent. per annum, and there are no reasons in sight why this rate of increase should materially decrease for years to come. The gas industry, while showing a somewhat less rapid rate of increase, has nevertheless maintained a steady and substantial advance.

Another fact of the utmost importance is that light is one of the absolute necessities. While its use may be restricted during times of financial depression, experience has shown within the past two years that such restriction, even in the most acute stages of panic, is comparatively trifling. Food, shelter and light we must have so long as we are alive, and their use therefore can never fall below the "irreducible minimum." It is a fact that the lighting companies came through the recent troublesome times in better shape than any other of the great industries; in fact, a very considerable number of the lighting companies actually increased their business during the first year of the depression. A corporation supplying a necessity of life is like real estate in the business section of an established city; fluctuations in its value will always be a minimum.

Besides furnishing one of the prime necessities of life there are a great number of cases in which a lighting company has a monopoly of supplying this necessity to its community. Without touching upon the endless theme of the right and wrong of monopoly, there can be no question as to its advantages to the corporation possessing it. There are some public utilities, furthermore, which, all arguments to the contrary notwithstanding, possess the quality of monopoly in the nature of things. While the supplying of luminants does not wholly come under this head, it doubtless partakes somewhat of the character of a natural monopoly. This opinion is substantiated by the division of the Public Utilities Commission of this State having jurisdiction in New York City, by its recent decision against the establishment of a competing electric lighting company. There are a large number of examples of lighting companies possessing an absolute monopoly of both gas and electricity that so conduct their business with the public as to secure not only freedom from criticism, but a large measure of evident and positive good will. It has been said that the best government of all is an absolute monarchy, provided you have the right monarch; and, all things considered, the best service will be furnished by a lighting company possessing an absolute monopoly, provided it has the right management. The numerous examples where such management is given show that it is by no means an impossible nor even rare condition.

As a financial element working toward the safety of lighting company securities as investments may be mentioned the important part which such a company plays in the progress of the city in which it operates. The value of good public lighting as an advertisement has long been recognized by private corporations, and within the past two years the fact that it can be turned to equal advantage in promoting the welfare of the city or town as a whole has been rapidly gaining ground. City after city has, within this period, put in elaborate and extensive lighting installations for the express purpose of advancing its general prosperity. Prosperity to the city means added revenues to the lighting company; self interest, therefore, would dictate a liberal and aggressive policy on the part of the lighting company to promote public progress.

In considering lighting company securities we have treated the subject on the basis of such companies supplying only the means of producing light; but the collateral branches of heat and power are always important adjuncts of their business, and afford equally great opportunities for expansion, thereby adding a very substantial increment to their earning power.

All things considered, the securities issued by the lighting companies that have a record for efficient management and a broad and liberal policy toward the public would seem to possess more factors of safety, and greater promise of uninterrupted dividends than those of any other class of industrial corporation.

Some Aphorisms that Are Worth Reading

"Clever" advertising matter is too often only a painfully apparent straining after an effect which it just misses making. A little leaflet was going the rounds at the National Electrical Contractors' Associaion convention at Toledo, Ohio, which was written for the purpose of advertising a leading make of electrical fittings, and in which the shots of wit and wisdom hit the mark with unusual accuracy.

The first page of the leaflet bore the modest title, "A Few Near-Thoughts Mostly Evolved from the Inner Consciousness of Tom Ringgold." The following are extracts:

Take the Inspector home to dinner with you occasionally.

Who's the Boss? You, or your business?

Never talk to a woman through an ink bottle.

A crook is a crook, regardless of the dimensions of his crookery.

Ordered your 1910 airship yet?

'Tis a wise man that knows the lowest price.

The tide never goes out so far it can't get back. Business never gets so low it can't return to its normal level.

"Go to the ant, thou sluggard. Learn her ways and be wise." Yes, and if you will give either more or less attention to the "ante" you will be wiser.

Mary had a little lamb;
Its legs were long and slender;
And everywhere that Mary went,
The lamb was sure to 'tend her.

Just like a woman—always got to have something tagging around after her. Ever tag?

"Six days shalt thou labor, and do all thy work." But you can do it in five, if you use wiring devices.

Know more than your employees!

Why is a man "all in" when he is all out?

"I'd like to give you the job, Old Man, but your price is high. Now if you can shade it a bit, to meet the other fellow's I'll see what I can do," etc.

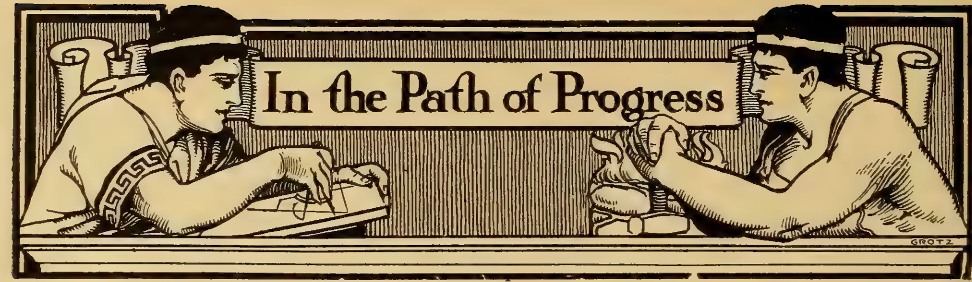
HELP! HELP! HELP!

Is your catalogue file in shape?

Don't be stung—clubbed—persuaded—jollied — bribed — threatened — scared —or deceived into breaking your agreements. If you are not man enough to keep them, don't make them.

You need knowledge in your head more than goods on your shelf. Now is the period in which you should give heed to the future, and after discovering about what contracts will be let in your vicinity, decide what proportion you are entitled to. Then prepare to get them. Then get them.

Clean your windows, paint your front and see that your electric sign is a credit to you, as an electrical expert.



Illuminating Engineering as Seen by "The Gasarc"

The Gasarc, bearing the imprint "Volume 1, July, 1909, Number 5," has just reached us. A perusal of its contents discloses the fact that it is the house organ of the General Gas Light Company, Kalamazoo, Mich., generally known to the lighting fraternity as makers of the Humphrey Gasarc. As this is the first number that has come to our notice, we will follow our usual custom of reviewing it as a new publication.

This issue is the usual six by nine size, of twelve pages, and is printed on India tinted paper. The increasing use of paper of this or a similar tint is worthy of notice from the illuminating engineering standpoint; it is a recognition of the fact that a surface having a tint of some mellow shade in which yellow predominates is distinctly restful to the eyes, in comparison with a pure white surface. When in addition to this restful color a dead or matt surface is used the combination affords the highest degree of ocular comfort.

Judged by this issue, *The Gasarc* is well written and ably edited, and can well hold up its head among the best of its class of publications.

Among the articles is one entitled "Illuminating Engineering," which is particularly interesting from the truly humanistic view which it takes of the subject. By way of introduction the writer says:

> *The Gasarc* is in hearty accord with the aims and achievements of real illuminating engineering. It has, however, been constrained to look with some suspicion on the recent promotion of various societies purporting to be formed for the careful study and interchange of ideas on illumination subjects. There has been a noticeable lack of calm, deliberate balancing of one system as compared with another which is ordinarily looked for in the transactions of scientific men. The readiness with which the flop from the unreserved condemnation of large unit lighting to an enthusiastic appreciation of certain forms of it following immediately on the bringing out of glassware or clusters of lamps permitting the commercial exploitations of high power light sources might strike one as peculiar.

And a little farther on: "We make the claim that we have been doing more to raise the standard of gas lighting than any other company in this country."

The article then discusses in an intelligent manner the question of maintenance of gas arcs, and cites some special instances to prove the contention of the superiority of the gas arc over individual mantle burners. Concluding the argument, the writer says:

> There is unquestionably a use and field for the inverted small unit gas burner, just as there is for the arc lamp, but each have their particular scope and the merchants of Atlantic City have been poorly advised and educated along improper lines, for the gas fixture and small unit of burner should not be used as a general medium for illumination for stores, except in certain rather rare instances, although a large number of their stores are so lighted.
>
> Then the appearance of the store in most instances is not beautified by having fixtures installed, nor is the same candle power obtainable.
>
> Certainly a stable for horseless carriages is not the place for fixtures, inverted burners and holophane glassware.

To clinch the argument by ocular proof two lighting installations are shown (photographs taken by daylight); one an automobile garage, apparently lighted with chandeliers supporting three inverted

mantle burners with prismatic glassware; the other a drug store lighted with three gas arcs. The former bears the caption, "A 'Scientific' Installation?" the latter "A Humphrey Installation." Which of the two is the better lighted, and why, is not quite clear to us.

Taking a general survey of the article from an airship point of view, from which the various methods of lighting appear in their true perspective, we are strongly reminded of the well meaning efforts that have been made, from time to time, to bring all of the various religious denominations into one fold. This is an easy enough task, as the Methodist sees it; all that is necessary is for the other denominations to recognize the error of their ways, and embrace the true faith of Methodism; and so with the other isms. The old definitions of orthodoxy and heterodoxy contain a deal of human philosophy: "orthodoxy is my-doxy, heterodoxy is your-doxy." *The Gasarc* has a wholesome respect for "real illuminating engineering," which may be known by its wise use of the gas arc; and with true piety it laments the tendency displayed by certain societies to wander off after strange gods in the form of individual inverted burners equipped with prismatic shades. It is painfully apparent that the fair name of this new science has been prostituted to the selfish ends of promoting the sales of particular lighting devices—other than gas arcs.

Truly we are all very human; and no amount of science, or profession, or association will ever take away our inalienable right to toot our own precious horn. And after all, would it not be a very monotonous existence if there were no horns tooting? Whether we shall ever hear the "music of the spheres" we know not; meanwhile let us incline our ears with due appreciation to the worldly and human tooting of horns, and each do his best to "make a joyful noise."

Engineering Illumination for Money

There is this characteristic difference between America and Europe in its attitude toward the development of science: America pursues science for the money there is in it; Europe pursues it for honor and glory. The results from following the subject from these two viewpoints are precisely as would be expected: Europe leads in theoretical discovery; America leads in practical application. Eliminate the motive of financial gain in America, and the path of its progress in science would "dwindle into a squirrel track and run up a tree." Unless, therefore, we are willing to drop out of the line of march of progress altogether, we must accept the motive, which has led us on to so many brilliant victories, at its face value.

There are always plenty of individuals content to sit on the fence and see the procession go by, grumble if the dust gets into their eyes, and drop meekly in among the stragglers at the tail end. The progress of illuminating engineering affords a recent example; and mutterings may still be heard, if one has the time or patience to listen, that the whole thing is a commercial scheme, concocted by certain lighting interests for the purpose of boosting their own game. As if the grumblers would not boost *their* own game if they had the foresight to grasp an opportunity!

Let it be distinctly understood, now and forever, that illuminating engineering in this country has been developed by commercial interests as a direct means of increasing their business; and its future development will as surely arise from the same source and motives. Let it also be just as clearly understood that every branch of applied science which has been brought to such a marvelous state of perfection in our glorious country owes its development to precisely the same sources. It would be quite as absurd to sneer at electrical engineering, and all the vast enterprises which it represents, as being only a "sales proposition" as to rail at illuminating engineering on the same ground.

"Open confession is good for the soul." Let us frankly admit that Americans work for money, and let results justify the motive. Surely in accomplishment we have no reason to hide our heads in shame. Nor in respect to general intellectual and moral worth are we quite ready to acknowledge inferiority to any race of people on the face of the earth, now or in the past. To deny the chief incentive of our national and individual greatness

is a species of snobbery not less despicable than to disown one's parents because of imaginary humble origin. The breed of the fox that was sure the grapes were sour shows no sign of becoming extinct. Tainted money is mostly that which we haven't got, and the unpardonable sin in working for money is to succeed; all of which applies to the development of illuminating engineering in America.

Among commercial interests that have been instrumental in promoting this new line of scientific progress, the Holophane Glass Company, by common consent, stands among the leaders. Granting at once that the ulterior motive has always been the financial prosperity of the company, the fact is undeniable that the efforts of this company and its allies have had a large influence in establishing illuminating engineering as a legitimate and distinct branch of science.

With this preamble we will now let the Holophane company speak for itself:

With the issuing of a new Bulletin (No. 23), devoted to Holophane-D'Olier steel reflectors, the Holophane Company launches upon a very aggressive campaign to develop industrial plant lighting. As is well known, such lighting has not received much attention from the scientific standpoint. Illuminating engineers and manufacturers of lamps and lighting equipment, with one or two notable exceptions, have let this important branch of lighting take care of itself. Having perfected their line of steel reflectors they will devote a considerable portion of their attention to this work in future.

Beginning September 1 the steel reflector department will have several engineers working exclusively upon factory and shop lighting. These engineers will be prepared to undertake any problem in industrial lighting that may be offered, and their services are placed, without charge, at the disposal of central stations, electrical contractors and supply dealers.

HOLOPHANE-D'OLIER REFLECTOR, NO. 72.

The new line of steel reflectors is well worth careful study. Every detail of design and manufacture has been improved. A new type of ventilated holder has been adopted which does away with overheating and deterioration of lamps. A better reflecting surface has been developed, which not only improves the efficiency but completely eliminates objectionable streaks or striations, and gives practically perfect color-value to the light.

Nernst Lamp Company Receivers Discharged

The following circular letter will be read with interest by all connected with the lighting industries:

I have much pleasure in being able to notify the customers and other friends of the Nernst Lamp Company that the receivers appointed October 24, 1907, by the Circuit Court of the United States for the Western District of Pennsylvania, were on July 24, 1909, discharged by the same authority. All of the matters which made a temporary receivership expedient have been satisfactorily arranged, and the company's position is greatly strengthened from every standpoint.

All contracts made by the receivers for the sale of the company's product, or for the purchase of materials or merchandise, will be carried out as though made by the company's own officers.

I take this occasion to announce the election of Mr. H. T. Herr as vice-president of the company, which completes the board, and with Mr. W. D. Uptegraff as vice-president and general manager, assures a competent executive administration.

GEO. WESTINGHOUSE, President.

While the progress of the company has been maintained during the management of its affairs by the receivers, it will nevertheless be a source of satisfaction to the general lighting field, as well as those directly interested in the company, that it has again come into its own.

It is particularly noteworthy that during the period while the protection of the court safeguarded the financial existence of the company against the storms of panic, the company did not halt, apparently for a moment, in the work of improving its product and keeping the Nernst lamp abreast of the procession,

which has been marching in double quick time in the past two years. There are none too many forms of light-source, notwithstanding their recent multiplication; and the extinction of any one that has proven its practical utility would be a genuine loss to illuminating engineers and the general public.

The fact that the Nernst lamp is again its own master is positive proof of its established value, and the competency of the receivers, as well as a guarantee of a still more successful career in the future.

The Moore Light Goes to Germany

The following interesting bit of news has just been received:

The Moore Electrical Company of Newark, N. J., has received an order for three installations of the Moore light in Berlin, Germany. The necessary apparatus has been forwarded and Mr. James A. Holt, who will have charge of the work, sailed for Bremen, August 5 on the North German Lloyd steamship George Washington.

A New Portable Incandescent Lamp Photometer

Many attempts have been made in the past to construct a portable photometer which should be in fact, as well as in name, portable and a photometer. The latest attempt in this direction comes from Germany, being announced by the firm of Siemens & Halske. The illustration shown herewith gives an accurate idea of the general construction of the instrument. A novel feature is the placing of the electrical measuring instruments in a permanent position in the screen boxes where they are readily in view. The necessity of revolving the lamp is obviated by the use of mirrors set at angles, so that the instrument is complete as well as accurate in its measurements. The name of the firm is sufficient guarantee of workmanship and precision.

Tungsten Sign Lamps

The tungsten lamp will undoubtedly prove as revolutionary in sign lighting as it has in general illumination. It is a plain fact in illuminating engineering that lamps for sign use should have their maximum candle power " end on." The Westinghouse Lamp Company, Bloomfield, N. J., is the first to apply this principle to its full extent in a small tungsten lamp.

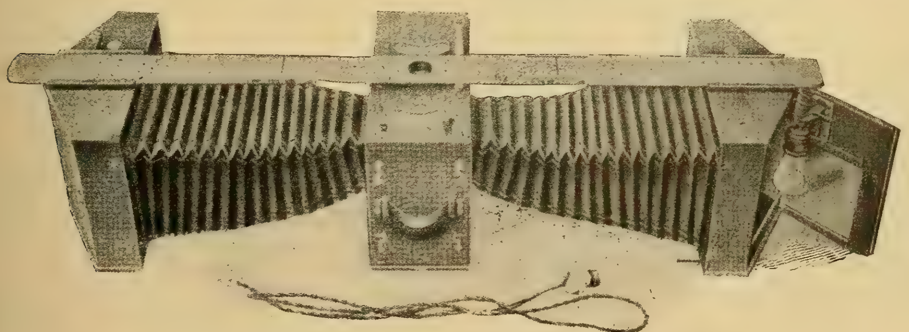
The following description of this new lamp was furnished at our request by the company:

No more important element has entered the electrically lighted sign world than the 5 watt, 4 cp., 10, 11 and 12 volt tungsten sign lamp.

This industry, which has extended its field of usefulness by use of the 2 and 4 cp. carbon sign lamp at 4.8 and 5 watts per candle, respectively, until the electrically lighted sign is a familiar sight in our smallest towns and our largest cities, has at last obtained a satisfactory and economical sign lighting unit in this tungsten sign lamp.

This little lamp, made up in the regular SS-14 or straight sided bulb 1¾ in. in diameter to give 4 cp. with an average life of 2000 hr. and a consumption of 5 watts per hour, approaches the ideal as a sign lighting unit.

The lamps are made in two types in the wire lamp class. One type, the regular lamp, is made of a single loop filament in the form of a V parallel to the axis of the lamp, with the apex to the top of the lamp and the wide spreading sides, forming a lamp of pleasing



THE SIEMENS & HALSKE NEW PORTABLE PHOTOMETER.

appearance; the other type, the W lamp, is made of two loops of filament, forming the letter W at right angles to the axis of the lamp, with the apex of each angle supported by spring anchor wires.

The filaments in these lamps are in one piece, wound on the supporting spring anchors and connected to the leading-in wires by a well-wrapped joint, thus eliminating the fused or pasted joints, the source of so much trouble.

The total watts consumed by these sign lamps are about equal to the watts required to produce a single candle power in the carbon type of lamp, thus effecting a saving in current of 100 per cent. over the 2 cp. carbon lamp and 385 per cent. over the 4 cp. carbon lamp with about equal life. The saving in current is, therefore, great, and the economy in the use of the lamp apparent.

The only thing necessary to use this highly efficient lamp on any sign is the proper combination of multiple series connection on direct current or the introduction of a small 1 to 10 transformer, or the multiple series connections on alternating current, preferably the use of the transformer.

The clear white light from these tungsten lamps gives signs a warmth and beauty new to the electrically lighted signs.

The Proper Lighting of Pictures

It is not always possible to give a picture the lighting necessary to bring out all its artistic qualities by daylight illumination. Especially is this the case in private houses, where the relation of wall space to window light cannot be adjusted to suit the needs of the picture. In one respect at least artificial lighting may be better than daylight; for with the aid of the most modern equipment it is possible to light a picture, no matter where it may be hung, so that its full beauty will be observable from every point of view. A device which seems to be particularly ingenious in its design and construction, and equally praiseworthy for its practical effect, has been recently offered to the public by Klemm & Co., of Philadelphia, with whose reflectors for general purposes the lighting field is already familiar.

THE NEW "KLEMM" REFLECTOR FOR PICTURE ILLUMINATION.

The device consists in a reflector running practically the entire length of the picture and supplied with tubular electric lamps. The fittings of the reflector enable it to be adjusted to exactly the proper position and angle required by each individual picture; and any finish that can be given to make it harmonize with the frame. The old trouble of having the glass of a picture become a glare of light by reflecting the light-sources used for general illumination can now no longer have an excuse for existence.

A New Line of Moderate Priced Tungsten Fixtures

The Central Electric Company, of Chicago, may rightly be classed among investigators, as well as a successful business institution; in fact, its success is due in no small measure to its investigating propensities. The line of its research is to discover actual needs of the people that have either not been previously filled or filled in an imperfect or unsatisfactory manner, and having made the discovery to proceed to remedy the conditions. The Price-McKinlock Company of Boston, likewise keep an ear to the ground to detect coming footsteps in the path of progress.

The following excerpt from one of their recent communications in as example of the above statement:

Up to the present time comparatively little attention has been devoted by manufacturers to the production of moderate cost lighting fixtures which, in addition to taking advantage of high efficiency lamps and reflectors, would also have an artistic appearance comparable with the more expensive creations.

In the past it has too frequently been the custom of the fixture manufacturer, as well as the dealer, to practically ignore the vital relations of the various elements, and the re-

THE NEW "OPALUX" TUNGSTEN FIXTURE.

sult has been a combination of fixtures, reflectors and lamps which, while reasonably efficient from an illuminating standpoint, were frequently little short of hideous from an artistic standpoint.

Appreciating the demand for a well-balanced, moderate-priced lighting fixture for use with tungsten lamps, the Central Electric Company, Chicago, Ill., in conjunction with the Price-McKinlock Company, Boston, have developed a complete line of Opalux Tungsten Fixtures, consisting of seven distinct designs, one of which is shown in the accompanying illustration.

These designs differ from the ordinary type in that science and art have been successfully combined to produce an ideal system of illumination at a comparatively small expenditure. The construction of the fixtures is substantial, correctly designed and so proportioned in relation to the reflectors that the lamps will give the very best results.

The Opalux reflector is particularly well adapted for use with high efficiency lamps, as it not only transmits sufficient light to prevent deep shadows on the ceiling but, owing to its diffusing surfaces, gives a distribution free from glare. Another advantage of the Opalux reflector is its freedom from tendency to collect or retain dust, as is inevitable with the ordinary type of reflectors having more rough or uneven surfaces. Again, it has been demonstrated by actual test that Opalux reflectors suffer far less from a deposit of dirt than the ordinary type, for the reason that the reflecting surface is entirely on the inside of the bowl, so that any deposit of dirt and dust on the outer surface has practically no effect on the efficiency of the reflector.

Westinghouse Storage Battery Company

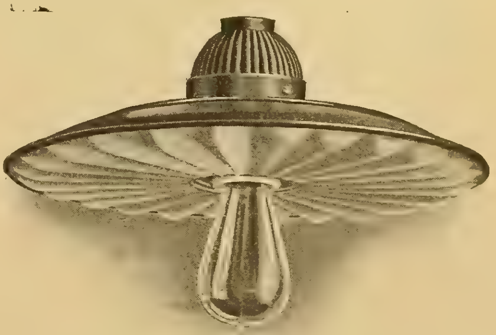
A company bearing the above title announces that it has acquired the entire interests of the storage battery department of the Westinghouse Machine Company and of the General Storage Battery Company and will hereafter conduct the joint business from their factory at Boonton, N. J.

The General Storage Battery Company manufactured a battery developed by Mr. Joseph Bijur, who had formerly devoted much time to the design of arc lamps, and who was one of the very first electrical engineers to foresee the possibilities and the future of illuminating engineering. The new company certainly has all the "outward and visible signs" of success, as well as a large measure of good will, to which we desire to add our own best wishes.

Wheeler Street Fixtures

The illustration below shows the Wheeler fluted street reflector, made by the Wheeler Reflector Company, Boston, which has been given such prominence by authorities in street illumination for the last year and a half. This distinction it owes in part to the substantial mechanical construction of the fixture to which it is attached, but largely to the effective light distribution it affords.

By placing a hood over the fluted reflector to serve as a watershed, the general outline of the reflector can be flat, and by a nicely calculated adjustment of the reflector to the position of the fila-



WHEELER TUNGSTEN STREET REFLECTOR.

ment, a light distribution is given with a maximum at an angle of 15 degrees below the horizontal, which is the most serviceable angle in street lighting.

The Wheeler Reflector Company has the only enameling plant in the United States whose product is confined exclusively to reflecting surfaces.

This reflector, then, is designed by a company that has been specializing on reflecting surfaces for nearly thirty years, is finished in its own enameling plant, which makes nothing but reflecting surfaces, and is assembled with other parts in the factory producing it; so that any defective or imperfect parts can be rejected at the various stages of assembling, all of which makes for perfection in detail and perfection of the whole.

Progress of the Carbon Arc Lamp

The new arc lamps have been of such a spectacular character in their results that the carbon arc, which has done such long and faithful service, has been for the time quite lost sight of. While predicting the complete extinction of this form of lamp in the future, however, the fact should not be overlooked that it is still by far the most used form of electric arc, and furthermore, has certain properties which especially qualify it for use where the flaming and metallic arcs, in their present state, can hardly hope to enter.

Although the newer forms of incandescent lamps give a whiter light than the older forms they do not by any means give a *white* light. Where daylight color value is desirable or necessary the carbon arc stands alone to-day as the one available light-source for interior use. When to this advantage is added high efficiency, steadiness and reliability, it will appear that the carbon arc has still a long lease of life. Nor has the carbon arc in the past reached its limit of perfection, and according to the old adage, " in the absence of perfection improvement is possible."

One of the most recent perfected types of carbon arcs has just come before the public under the trade name of " Sunray." While this lamp uses carbons of small diameter, it is not designed on the miniature plan. It was long ago established that the higher the current density in the carbon—that is, the smaller the carbon for a given wattage—the higher the absolute efficiency. With a keener eye to economy this principle has been taken advantage of in Europe to a much greater extent than in this country. But lamps of this type of European design have invariably been found far too delicate in mechanism to withstand American usage. The Sunray lamp is an attempt, and apparently a highly successful one, to take advantage of the high efficiency of the small carbon together with the longer life of the enclosed arc, both being utilized by a simple, practical American construction. The result is a lamp of a satisfactory life,—about eighty hours,—a higher degree of efficiency, and of a mechanical design that is susceptible of highly decorative treatment. These qualities admirably adapt it for store lighting and other interior use where quality and efficiency are items of importance. It is manufactured by the Sunray Electric Lamp Mfg. Company, 109 West Forty-second street, New York.

THE " SUNRAY " INDOOR LAMP.

Proceedings of Technical Societies

The Twelfth Annual Meeting of the International Acetylene Association

Reported by A. Cressy Morrison.

The twelfth annual meeting of the International Acetylene Association was held at the Knickerbocker Hotel, New York City, August 9, 10 and 11. The meeting was the most successful in the history of the organization. The attendance was larger; the papers were followed with the closest possible attention; twenty-eight new members were added, bringing the total to one hundred and fifteen.

The progress of the acetylene industry is well reflected by the rapid advance of the International Acetylene Association. Collateral interests were awakened to the utility of the association and were exceedingly well represented. These allied industries include manufacturers of burners, locomotive headlights, the dissolved acetylene industry, which includes the manufacturers of automobile and railway lighting tanks, manufacturers of marine torches, contractors' lights, miners' lamps, bicycle lamps, electric ignition devices, oxy-acetylene autogeneous welding apparatus and innumerable other devices which are developing with great rapidity and the uses of which are spreading very widely.

A number of notable papers were presented, among them a very clear cut statement of the relations which exist between the manufacturers of apparatus and the manufacturers of calcium carbide, from which acetylene is derived. Some facts were disclosed in this paper which have not been generally known. Among them the statement was made that the fundamental patents for the manufacture of acetylene generators had been acquired by the manufacturers of calcium carbide, and that the sole purpose of acquiring these patents was to enable the manufacturers of acetylene generators to pursue their avocation without interference from others. In other words, the acquirement of these patents was not for the purpose of monopoly, but rather to prevent it. This apparent reversal of what the public regards as the usual course of monopoly came like a breath of sweet country air to a dweller in the city. The efforts of the Union Carbide Company to advance the industry were outlined, the far-reaching character of which came as a surprise to many of the members.

The progress of the acetylene generator and the development of perfect burners which will not carbonize has been such that no papers relating to these two subjects were presented, the evolution having been sufficiently complete so that the advances during the past year, while effective, were in a sense minor.

A most notable paper was presented by Dr. Herbert E. Ives, of the United States Government Bureau of Standards, who has been conducting a series of investigations as to the relation of the various illuminants: First, to daylight—that is, the blue sky or cloudless sky—using as a basis the observations on daylight throughout the world collected by Professor Nichols, and later some recent and thorough research on the relation of illuminants to the sun. The general conclusion reached by these observations is that the artificial illuminant is considerably farther away from sunlight than has been believed by even the best authorities. A frequent claim is made that an artificial illuminant is a spark of the sun itself,

and scarcely any of the more modern developments of illumination have escaped this crowning statement, which is presumed to settle all questions as to the value of light, all of which goes to show that man has a large field for improvement before he turns night into day. Some of the very best of modern illuminants, including the electric arc, acetylene, the tungsten lamp and the Welsbach, burning under ideal conditions, are close to sunlight, and it is a neck and neck race with acetylene slightly in the lead. The nearest approach to acetylene is the electric arc, and in some respects it might be regarded as the equal of acetylene, but it has an excess of violet rays which, when thrown into the average, leaves it slightly behind. Mr. Ives' paper was extremely well received and showed a remarkably careful investigation. When the official report of the Government is issued it will undoubtedly prove a surprise to many of those engaged in the solution of illuminating problems.

One notable paper was presented by Mr. Oscar F. Ostby, of the Commercial Acetylene Company, showing the controversy which has arisen throughout the country before legislative bodies in relation to the selection of the proper headlight for locomotives. A very consistent effort has been made in several States, in some cases successfully, to secure the passage of laws compelling railroads to use only electric headlights. Mr. Ostby, in his paper, took the position that it was unfair to the railroads to compel the use of a single illuminant, as it would prevent progress and prevent the utilization of an even better means of illumination should it be developed. A series of tests were given which disclosed the value of acetylene in this particular field, and the statement was made that in most cases the attempt to legislate for electricity exclusively was defeated.

The second day of the convention included a trip to Pleasure Bay, where a genuine Rhode Island clambake was indulged in and, much to the joy of the initiated, real Rhode Island clams were served. The Western contingent, never having encountered the succulent bivalve, did yeoman service in disposing of the pyramid of steaming delicacies, which included, of course, lobsters, green corn and all the fixings. For the united New Yorkers, who did not and never have known a clam when they see it, the despised quahaug, commonly known as the little neck clam, which is not a clam at all, was included.

The convention closed with an automobile trip to Coney Island and a banquet at Luna Park. As everybody was provided with books of tickets to the various places of amusement, the association bumped the bumps, slid the slides, indulged in the Virginia reel and closing noisily, found the waiting automobiles which hurried them back to New York.

The whole industry responded to the cordial efforts of the Entertainment Committee and the good fellowship which was built up was not only characteristic of the association, but even surpassed all previous occasions.

Mr. Oscar F. Ostby, of the Commercial Acetylene Company, New York City, was elected president to succeed Mr. M. J. Carney, of Chicago. Mr. A. Cressy Morrison, of Chicago, was elected to succeed himself as secretary and treasurer. Both the elections were by acclamation.

Miscellaneous

FACTORS THAT SHOULD BE CONSIDERED IN MAKING STREET LIGHTING CONTRACTS, by Samuel Rust; *Read at the Convention of the Ohio Electric Light Association.*

The writer groups the factors under the following heads:

Length of contract, kind and number of lights, changes in position of lamps, outages, schedule burned, time of payment, costs of service and manner of contracting.

Taking up the first of these the writer points out the very important fact that the progress of the art has been such in the past as to render a complete change of installation necessary every ten years. Provision for taking advantage of improvements in the arts is an important factor, which was forcefully brought out in the Colorado Springs controversy, which had its origin in the change of electric lamps made during the life of a

twenty-five year contract, the change being practically essential to keep up with the progress of electrical improvements. Mr. Rust has this to say on the subject:

The length of time that a street lighting contract should run is a very essential factor to be considered by both parties to the bargain. The statutes of Ohio have fixed the maximum at ten years. The question is, should contracts be for any less period? If the company is a progressive one and keeps abreast of the times in adopting new improvements for their street lighting service, it should most assuredly not be less as every such company can count upon completely changing its street lighting equipment at least once in every ten years and this calls for an outlay that shorter time contracts will not justify. Every street lighting contract should provide that the company furnishing the lights should have the right to change their system to a newer or better system of equal or better intensity during the life of the contract, subject to the approval of the council or board making the contract. Instead of this provision injuring the municipality, it would benefit it by giving it the benefit of the improvements in electrical service which are appearing quite frequently and it would be an incentive to the company to furnish the city with the best and most up-to-date service.

On the question of the kind of lamp to use Mr. Rust says:

The kind of lamps to be used in lighting a town or city must depend somewhat upon the size of the municipality. Companies should be careful not to overlight a city in the beginning, as all municipalities grow rapidly and there is a constant increase in the number of lights wanted, the lighting bill may become too great in comparison to other city expenditures and produce dissatisfaction. While most municipalities do not make any mistake in this regard and are generally underlighted, there are some that have more lights than the city can well afford to pay for. This is like overselling a man in goods. He may pay for the goods, but it always results in a dissatisfied customer.

So far there has been nothing invented for street lighting superior to the arc lamp. The reliability of its rays and ease of arranging its circuits have made it a favorite in any contract for street lights. In view of the recent invention of the series tungstens, a price should always be agreed to for the installation of smaller units in out of the way places in order that the city may light dark spots at a less cost than the arc lamp, which is too large for the purpose. Series tungstens are now made to fit the amperage of almost every size arc lamp and can be installed on the same circuit and operated simultaneously with the arc lamps. Reports from this class of lighting are all favorable as to its satisfactory operation and length of life. In the smaller municipalities it is a question whether the series tungsten will not in time supplant arc lighting entirely. Its economy of consumption and consequently lower price will enable the introduction of a largely increased number and avoid the shadows of foliage, which is always dense in the smaller towns.

Residence Lighting, by F. T. Mather, *read at the Convention of the Ohio Electric Light Association.*

The paper is devoted principally to a description of conditions and results obtained in Detroit, Michigan. The following excerpts are of general interest:

Detroit, with a population of about 360,000, has 13,000 homes lighted with electricity. Electicity has no competitor in the high-class residences, little in the moderate-priced homes, and considerable buisness is secured among the owners of small cottages. Few homes are now built without electric wires. The proportion of old houses wired for electricity is increasing every year.

The rapid growth of this class of business dates from 1898, when the present Detroit residence rate was adopted. Its peculiarity lies in the method used in determining the amount to be charged monthly to each consumer at the primary rate, which is 14 cents per kw.-hour. The amount so charged is 2 kw.-hours per month for each room counted. Unfinished attics, storerooms, laundries, closets, bathrooms, stairways, halls, servants' rooms, kitchens, pantries, porches and vestibules are not counted. Before adopting this method the Detroit company ascertained by observation that the number of lamps likely to be burned at the hour of the district maximum was actually very closely proportional to the number of these living rooms which are taken as the basis of primary charge. The secondary charge for electrical energy used in excess of 2 kw.-hours per room counted is 4 cents, and fans, flatirons, diskstoves and cooking devices are not counted on the demand charge, thus giving the customer the advantage of this low secondary rate for such devices.

American Items

NEW PUBLICATIONS.

Railway Electrical Engineer; monthly; Mackenzie - Klink Publishing Company, Monadnock Building, Chicago.

The August number of this journal, which is marked Vol. I., No. 3, is the first which has come to our hands. It is edited by Mr. L. B. Mackenzie, with Mr. Edward Wray as associate editor.

The first thought suggested by the title is the continued subdivision of the field of science, both theoretical and practical. This thought is still further impressed by an examination of the contents, which discloses the fact that electricity is dealt with only in so far as it is originated on or by the rolling stock itself, its use as a tractive force being entirely omitted. This reduces the field of the magazine to substantially that of electric car lighting, which is further shown by its announcement as the official publication of the Association of Car Lighting Engineers.

The August issue contains an abundance of excellent original matter, an amount in fact which will compare favorably with that of many of its older contemporaries covering far wider fields. Following are the principal articles:

New Passenger Terminal, Chicago and Northwestern Railway (Chicago); Railway Car Lighting, by W. E. Ballentine; Illumination of Railway Cars, by C. W. Bender; Investigation of Methods of Car Lighting, by Edward Wray; Intercommunicating Telephone, by E. I. Pratt.

All of these articles show intimate knowledge of the subjects treated by the authors, and are fully illustrated. There are two pages of editorial matter, a record of patents, and general miscellany.

The Cooper Hewitt Lamp Adapted to Glass Signs; *The Novelty News*, July.

Describes the use of the Cooper Hewitt lamp in the construction of transparent glass signs and gives an illustration of one of these signs recently installed in Chicago.

We some time ago called attention to the possibilities of this lamp for sign purposes and decorative lighting. Its distinct and less familiar color gives it the advantage of causing the sign, or other decorative feature, to stand out in sharp contrast with all surrounding light sources. It will doubtless have a wider use when its advantages for this purpose are appreciated.

Illumination for August.

Contains some original fixture designs, drawn especially for its use; an article on the "Art of Fixture Salesmanship," together with the usual news and correspondence. The announcement is made that beginning with September the name of the periodical will be changed to *Fixture Trade Review*.

Gas vs. Electricity, by E. N. Wrightington; *Light*, August.

Mr. Wrightington meets the objections commonly made by the electrical interests to the use of gas for lighting, and also sets forth its positive advantages as he sees them. These are stated with unusual clearness, brevity and freedom from the "talking point" style. His conclusion is a valuable piece of advice to those interested in the use of gas for light:

Having disposed of the various objections which have been raised from time to time against the use of gas, I return for a moment to the most important of the advantages. These are the economy and the quality of the light. I believe that too much emphasis in the past has been laid upon the savings effected by the use of gas to the slighting of the very great advantage in point of quality.

Until the introduction of the tungsten lamp, gas has been generally accepted as being a great deal cheaper than electricity, and ordinarily this point does not have to be argued or proved. I have shown above that with the new inverted gas lamp, the relative cost of the two sources of light has not been altered, at any rate to the advantage of electricity.

While it is true that gas has always held and will probably always hold a strong position from the economy of the light alone, it has been evident that in the past this advantage has not prevented many installations of electricity.

Now that the new burners and special glassware have so greatly improved the quality of the light, I believe that this advantage should be placed very prominently before the public. At the same time none of the other points should be neglected, and where we have so many advantages we should make use of them all.

Illuminating Business, by M. L. F. Blyler; *Light*, August.

Mr. Blyler appeals to gas companies and fixture manufacturers to make a greater use of illuminating engineering in the promotion of their common interests.

Compressed Acetylene, by J. M. Morehead; *Acetylene Journal*, August.

The fact that attempts to compress acetylene gas led to several disastrous explosions at the very beginning of its commercial use has been a handicap to the industry ever since. Definite knowledge upon the subject is, therefore, of particular value. Mr. Morehead gives the ascertained facts in regard to acetylene, as well as the general principles governing the compression of gases.

The four principal characteristics of acetylene, which must be reckoned with in compressing this gas, are:

First.—The generation of the acetylene from 1 lb. of calcium carbide and water gives rise to 725 heat units.

Second.—The addition of each 1 lb. pressure to acetylene entails an increase in the temperature of this gas of 6 degrees F.

Third.—Calcium carbide, when mixed with water in a closed container, is capable of generating a pressure in excess of its liquefaction point, which is 750 lbs. per square inch.

Fourth.—Free acetylene, subjected to a pressure in excess of 25 lbs. per square inch and subjected in any part to a temperature in excess of 538 degrees F., will dissociate with explosive violence.

Church Cross Lighting; *Progressive Age*, August 2.

Describes and illustrates an illuminated cross, used in St. Mark's Church, Denver.

Demonstrating Illumination in New Haven; *Selling Electricity*, August.

Describes the method used by the manager of the local electric light company to awaken interest in better lighting and educate the people to the present standards of illuminating engineering. The chief feature was the delivery of a course of free lectures on the subject, which were supplemented by practical demonstrations. The effort is represented as having been highly successful.

Lighting: Gas and Electric; *Engineering Review*, August.

This is the title of a new department in this well known journal, which is devoted to heating, ventilating, plumbing and lighting. The department in this issue contains two short articles; one on "Light Studies," which explains the law of reflection from the plain mirror; the other on "Lighting Country Homes by Private Electric Plants," by T. H. Amrine, reprinted from a bulletin of the University of Illinois.

The Principles of Illumination; *Electrical Age*, August.

An unsigned article containing a mass of mathematical formulæ and tabular data which seems to have been taken somewhat at random from existing authorities.

Extension of Artistic Show Window Lights, by "R"; *American Gaslight Journal*, August 16.

Gives suggestions for a number of window signs illuminated by means of inverted burners.

Foreign Items

COMPILED BY J. S. DOW.

ILLUMINATION AND PHOTOMETRY.

THE REPORT OF THE DEPUTATION APPOINTED BY THE CORPORATION OF LONDON TO VISIT AND REPORT UPON THE METHODS OF LIGHTING IN USE IN CONTINENTAL CITIES (*J. G. L.*, July 20; *G. W.*, July 19; *Electrician*, July 16; *Electrical Engineering*, July 22; *Elec. Engineer*, July 16).

EDITORIAL COMMENTS UPON THE MATTER (*J. G. L.*, July 20; *G. W.*, July 17; *Electrician*, July 16; *Elec. Review*, July 16).

This report has given rise to a considerable amount of discussion in both gas and electrical periodicals, the former in general greeting it with approval, while the latter regard it with disfavor. It is urged, for instance, that the suggested methods advocated in the report are too entirely molded on those prevailing in Berlin, where the conditions are not indentical with those in London; also that the deputation would have done well to have taken some expert advisers with them. The report summarizes the conditions of lighting in the chief continental cities and winds up by advocating the adoption of high pressure inverted incandescent gas lamps, placed centrally and equipped with raising and lowering gear; no actual decision is to be taken, however, before further experiments have been carried out. At present, as will be seen, the deputation seem to form conclusions very different from those recently arrived at by the authorities in Boston.

THE ART OF WINDOW DRESSING AND LIGHTING (*The Draper*, June 26, July 3, July 17).

Some discussion of opinions recently expressed by Mr. L. Gaster on shop window lighting. Several writers defend the use of powerful and bright sources of light to attract custom. In a subsequent letter Mr. Gaster states that he has no objection to plenty of light properly distributed, but deprecates placing these bright sources of light in the field of vision.

THE WORSHIP OF LIGHT, by Dr. M. Gaster (*Illum. Eng.*, London, July).

The author discusses the religions of tribes and nations in different parts of the world, pointing out how, in many cases, religious beliefs are all traceable to the worship of light and the heavenly bodies.

THE PROPOSED INTERNATIONAL UNIT OF CANDLE POWER, by C. C. Paterson (paper read at Physical Soc. of London, June 11; reported *Illum. Eng.*, London, July).

The author briefly summarizes the position as regards the international unit of light. The discussion turned mainly on the merits of different types of standards, Dr. Fleming expressing disapproval of flame-standards and advocating further research on the Violle apparatus, while Dr. Drysdale preferred a standard based on a truly black surface of specified dimensions maintained at a certain prescribed temperature.

LICHTEMFINDLICHES PAPIER IM DIENSTE DER BELEUCHTUNGSTECHNIK, by Riedl.

Describes a method of using light-sensitive paper as an aid in judging illumination. This is accomplished by reference to a standard sheet of graded paper. The author explains, however, that the method is only relative and can only be applied to the comparison of lights of the same class.

ILLUMINATION, ITS DISTRIBUTION AND MEASUREMENT, by A. P. Trotter (*Illum. Eng.*, London, July).

The author discusses the Ritchie wedge and describes an experiment to show that "angle-errors" are less serious in

photometry than theoretical calculations would suggest; he also describes several types of photometers based on the Ritchie type of instrument.

A Standard of Daylight Illumination in Interiors (*Illum. Eng.*, London, July).

The author discusses the conditions of daylight illumination in buildings and suggests a method of comparing the existing conditions within an interior with those due to the unrestricted illumination outside. He gives the result of a number of such determinations in different buildings in London.

The Photometry of Differently Colored Lights, by L. Wild (*Electrician*, July 16).

Describes some experiments with flicker and other photometers by the aid of which a metallic filament lamp, running at 1.5 watts per candle, is compared with carbon filament one. The author finds that the result varies 6 per cent., according as a flicker photometer or an instrument, depending on the "Equality of Brightness" or contrast principle is used.

Report of the Committee on Photometry of the Deutscher Verein von Gas und Wasserfachmännern (*J. G. L.*, June 26; *J. f. G.*, June 26).

The report accepts the term "lux" to indicate the illumination produced by one Hefner at a distance of one metre. The question of framing standard conditions for the testing of high candle power lamps has also been considered, but no decision yet taken. The relations on which the international unit of light is based are also accepted, but objection is taken to the term "International unit of light" on the ground that there is yet no satisfactory standard on which such a unit can be based.

The Lighting of Factories and Workshops (*Illum. Eng.*, London, July, 1909).

Discusses the most recent annual report of the Chief Inspector of Factories in this country. Instances of the recognition of the importance of proper lighting are commented on; an important statement is made by one inspector regarding the inconvenience arising from the fact that there is at present no adequate statutory legislation affecting illumination on which to rely.

The Design of Headlights for Vehicles (*Illum. Eng.*, London, July).

ELECTRIC LIGHTING.

Ueber Kohlefaden und Volframlampen, by A. Berninger (*Elek u. Masch*, June 27).

Modern Glow Lamps and Their Production, by K. Satori (*Illum. Eng.*, London, July).

Two contributions dealing generally with carbon and metallic filament lamps, and contrasting their properties as regards life, sensitiveness to change in supply-pressure, etc. Satori gives some particulars of the mercury-carbon glow lamp.

200 Volt, 16 Candle Power Metal Filament Lamps (*Electrician*, July 2; *Elec. Engineering*, July 8).

References to recent developments in low candle power, high voltage lamps; one interesting introduction has been the Stearn 210 volt, 25 watt and 16 candle power lamp, and other makes are expected shortly.

Beitrag zur Beantwortung der Frage nach der gunstigsten Betriebsspannung in elektrischen Beleuchtung, by J. Teichmüller (*J. f. G.*, July 17).

A discussion of the factors affecting the choice of supply-pressure, from the point of view of the new lamps. This article is interesting on account of its appearing in a journal devoted to gas-lighting, which, nevertheless, now frequently makes a point of receiving articles dealing with electrical subjects.

Die Wandlungen der Metalldampf lampen und der heutige Stand ihrer Entwicklung, by O. Vogel (*Z. f. B.*, June 30, concluded).

Die Popularisierung der elektrischen

Beleuchtung (*E. T. Z.*, July 1, 8, 15).

Elektrische Tischlampen und Wandarme (*Z. f. B.*, June 30).

A New Pattern Reflector Lamp (*Elec. Engineer*, July 16).

The Prices of Metallic Filament Lamps (*Elec. Times*, July, 1909).

Several numbers of this journal contain a summary of the chief makes of glow lamps in this country, with their prices and details as regards candle power and voltage, etc. (See also *Illum. Eng.*, London, July.)

GAS, OIL AND ACETYLENE LIGHTING, ETC. EDITORIALS.

Which Is Hotter, the Mantle or the Flame? (*G. W.*, July 10).

The Relation Between the Heat of Combustion and Incandescent Illuminating Power of Gases, by M. Sainte Claire Deville (*Illum. Eng.*, London, July).

The above article by M. Sainte Claire Deville, in which he seeks to explain the connection between illuminating power, calorific power of gas, flame temperature and other factors affecting the performance of an incandescent mantle has been much debated in the press. His statement of that the temperature of the mantle is invariably below that of the flame encircling it is received with some surprise in view of the ideas of a fundamentally different nature held by M. Meunier and some other French investigators.

High Duty Gas Lighting, by T. Holgate (*Illum. Eng.*, London, July).

The author draws a comparison between the performances and distribution of light from flame arc lamps and high pressure incandescent gas lights, referring to the previous results of Mr. W. R. Herring and Professor J. T. Morris on this point. He then proceeds to take up the various factors which control the performance of a gas light, dealing in the present installment of the article with "Quality of Gas."

The Mechanics and Physics of the Gas Flame, by T. Holgate (*G. W.*, July 24).

The Design of Atmospheric Burners, by A. Mansfield (*J. G. L.*, July 13; *G. W.*, July 10).

The Origin and Progress of Gas Lighting, by Todman (*J. G. L.*, July 6).

The Pharos System of High Pressure Gas Lighting and High Pressure Air Lighting (*J. G. L.*, July 6, 1909).

Blau's Liquid Illuminating Gas (*J. G. L.*, July 13).

Birmingham Gas Illumination (*J. G. L.*, July 13).

The Meeting of the Societe Technique du Gaz (*G. W.*, July 3; *J. G. L.*, June 29).

The Meeting of the German Institution of Gas and Water Engineers (*J. G. L.*, June 29; *G. W.*, July 3).

On Calorific Power and Calorific Intensity (*G. W.*, July 3).

Gas Lighting in the West Indies (*G. W.*, July 24, 1909).

Beautiful Acetylene Fittings (*Acetylene*, July).

L'Acetylene dans les Colonies Francaise (*Rev. des Eclairages*, July 15).

Contractions used:
E. T. Z. Electrotechnische Zeitschrift.
Elek. Anz. Elektrotechnischer Anzeiger.
G. W. Gas World.
Illum. Eng., Lond. Illuminating Engineer (London).
J. G. L. Journal of Gaslighting.
J. f. G. Journal für Gasbeleuchtung und Wasserversorgung.
Z. f. B. Zeitschrift für Beleuchtungswesen.

The Illuminating Engineer

Vol. IV OCTOBER, 1909 No. 8

THE DAYS WE CELEBRATE

Since man emerged from his primeval cave and uttered an intelligible language he has been wont to set aside the ordinary pursuits of life at varying intervals and devote a season to exercising that distinguishing human characteristic—the conscious appreciation of joy. The day of celebration is as old as the earliest geological traces of man.

It is a kindly provision of nature that our moments of joy are longest and most vividly remembered. That the great events of history which have most directly affected our personal welfare should, therefore, be made the occasion of special rejoicing is but a natural method of giving them an indelible impress upon the memory.

The discovery of the river which is to America what the Rhine is to Germany and the first successful use of steam navigation on this same river are certainly events worthy to be cherished in the mind of every American; and the fortnight of general rejoicing set apart to commemorate these events is timely and praiseworthy. The Hudson-Fulton celebration is an event of national and international importance.

Of the many elaborate, ingenious and expensive devices conceived for the purpose of making this a memorable holiday, which one will leave the most lasting impression? Can there be any doubt that it will be the special illumination? When those who witness the various allegorical and spectacular features of this fête seek to recall their general impression in after years, what will stand out most vividly? Unquestionably, the indescribable effect of the city and its environs gleaming with innumerable lights, multiplied by reflection in water and sky.

Light, light, everywhere a blaze of light; never to be forgotten, nor adequately described by those who witness it.

It is well to celebrate. It refreshes and strengthens us for the routine of life; and let our memories of these celebrations be of light—the symbol of truth, of progress, of the universal brotherhood of man.

Let there be MORE *light!*

E. L. Elliott.

The Development of the Oil Lamp

The origin of the simple oil lamp, consisting of a receptacle for the oil and some fibrous substance for a wick, is lost in the obscurity of prehistoric times. It is impossible to say whether the lamp or the candle was the first step in the evolution of artificial light sources from the primeval torch. Doubtless both were independently invented many times and in many countries.

From its earliest use until the present day the oil lamp has undergone but one radical and essential improvement. In seeking to bestow the honor of discovering this improvement where honor is due we find ourselves confronted with the same questions of doubt that surround nearly all of the great inventions and discoveries. Popular history always settles upon some one individual, ignoring all doubts and other claimants—often with no small degree of error and injustice. The truth of the matter is that there are few radical or epoch making discoveries which are the product of a single mind. The great invention or discovery, when carefully traced to its origin, will be found to have been the culmination of a growth, rather than a sudden creation. Often, indeed, the last step from the apparently useless or the imperfectly observed phenomenon to the practical application that marks the new era in human thought or industry is so short and so obvious as to produce amazement that it should not have been taken before.

These general observations were suggested by reviewing the history of the single radical improvement in oil lamps. By common consent the credit for this improvement is given to a Swiss by the name of Ami Argand, whose name is still familiarly connected with all forms of flame light sources having provision for a central supply of air. Unquestionably Argand brought the idea to a practical and commercial fulfilment; but that he was not the first to conceive the idea seems equally certain. That astounding universal genius of Italy, Leonardo da Vinci, whose mind seemed to have comprehended the whole range of the arts and sciences, observed that the flame of a lamp was steadied by piercing the wick. Our own Franklin is also credited with making the discovery. It is altogether probably that Argand developed the idea of the central draft wick from the suggestions of previous inventors. The fact that he actually achieved results which effected a revolution in artificial lighting, where his predecessors had but vaguely surmised and casually observed, entitles Argand to the full measure of credit due an inventor.

The two elements of improvement, namely, the central draft wick and the glass chimney, were not produced simultaneously. His first working model was produced in 1772, and gave a light " equal to 10 or 12 candles." As the monopoly

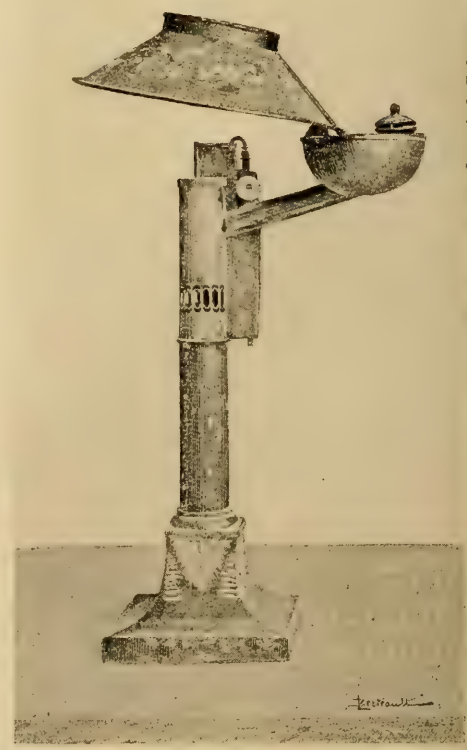


FIG. 1.—EARLY HAND LAMP, WITH CENTRAL DRAFT WICK.

Entered as Second Class Matter January 13, 1907, at the Post Office at New York, N. Y.

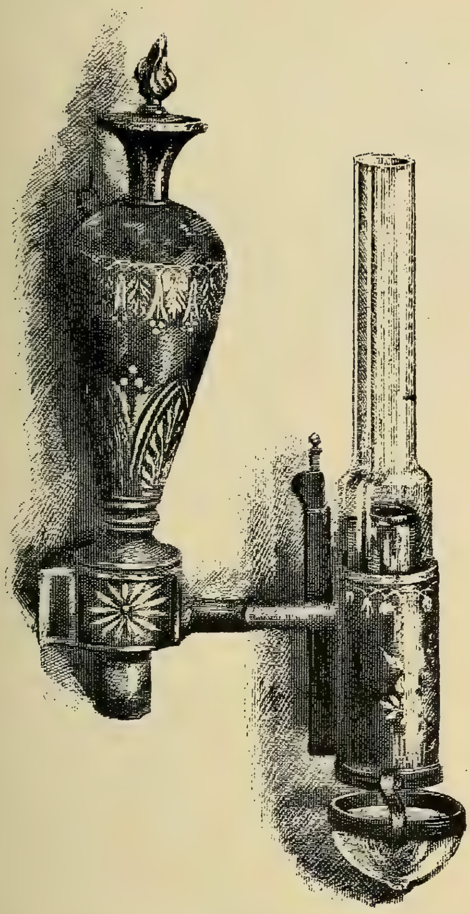


FIG. 2.—ARGAND OIL LAMP DESIGNED AS A WALL BRACKET.

of patent rights was not then as readily secured as now Argand's invention became public property in France, and numerous imitators quickly sprang up. Furthermore, the imitators were not satisfied with simply reaping the commercial rewards which belonged by rights to the inventor, but even claimed themselves to be the inventors.

The discovery of the glass chimney has been attributed to an accident. It is said that the bottom of a bottle having cracked off accidentally, Argand hastily set the bottle over a lamp and immediately observed that the wick burned with a very much whiter and cleaner flame. This is a pretty legend, but like many other traditions rests upon no better authenticity than "they say," and is probably only one of those adventitious growths which spring up so plentifully around historical events. A more likely explanation is that Argand first tried a metal chimney suspended just above the flame, and from this came naturally to the use of the chimney of glass surrounding the flame, which in its final form had a constriction just at the top of the flame, as at present.

Argand further improved his lamp by placing the oil reservoir above the wick and devising the means, still found in the familiar student lamp, of keeping the oil at a constant level about the wick.

Although in mechanical details the highest type of oil lamp at the present time is in every essential respect the counterpart of the lamp made by Argand, he has the distinction that belongs to but few inventors, of having taken the scat-

FIG. 3.—ARGAND OIL LAMP CHANDELIER.

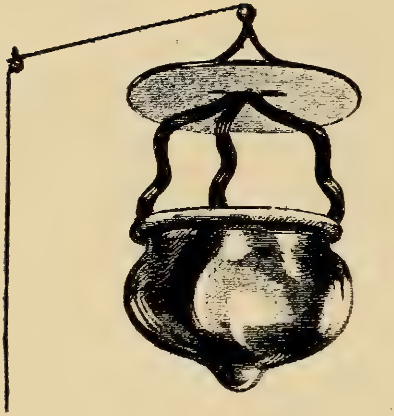


FIG. 4.—THE "OPTICAL" LAMP.

tering ideas and observations of previous experimenters and embodied them in a practical device, which he brought to substantial perfection.

If you would realize what this improvement in the oil lamp represents, compare the light of the student lamp with that of the smoking, ill smelling flame of a miner's lamp, which is the only existing representative of the lamp that held first place in artificial illumination from the beginning of history to the last part of the eighteenth century. The introduction of the Argand lamp distinctly marks the first epoch in that remarkable development in the production of artificial light, of which we are yet doubtless only in the beginning.

Having thus briefly traced the origin of these improvements, let us examine a few of the methods of its adaptation to the purposes of illumination. Fig. 1 shows a hand lamp with an oil receptacle at the side of the wick, provided with a reflector shade. As no chimney is shown, it is probably that this model was constructed before the use of the chimney was discovered.

Fig. 2 shows a lamp intended to be supported on a side wall. Observe that every detail is present, including the drip cup, the rack and pinion for raising and lowering the wick, the elevated oil tank, and the glass chimney with constriction above the flame.

Fig. 3 is a central chandelier having the same mechanical construction, the chimneys being removed. As would be expected from the period and the country in which it is made, the chandelier exhibits a high degree of artistic taste.

Argand's invention, however, by no means comprehended all of the experimental work directed toward improving the then existing sources of light, which had remained unchanged since the days of ancient Rome. Even the use of prism glass was foreshadowed about the middle of this century. In fact, the experiments extended even to the careful arrangement of the light sources with reference to the size and purpose of the room in which they were placed, thus establishing the principles of illuminating engineering.

In 1759 one Robiqueau produced his "optical lamp." This device is shown in Fig. 4. The Paris *Mercury* of that year speaks of a billiard room being lighted up "as bright as day" with only two of these lamps. Can our friends of the tungsten lamp and prismatic shade beat this record?

The imitative faculty in man is possibly responsible for his ascent from his arboreal progenitors into present day civilization. It is difficult to say in which the trait is more pronounced at the pres-

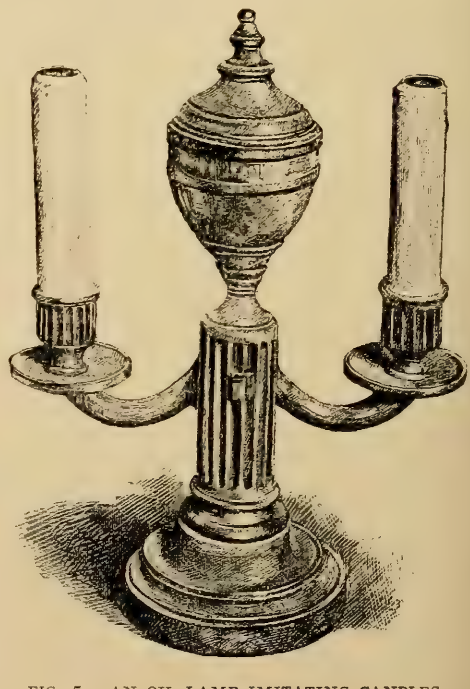


FIG. 5.—AN OIL LAMP IMITATING CANDLES.

FIG. 6.—WALL BRACKET FOR HOLDING IMITATION CANDLES.

ent time, ancestor or descendant. All art is directly traceable to the instinct to imitate nature. If we should carefully eliminate from our lives everything that we do because others have done it, or are doing it, we would doubtless find little left to account for outside of sleep. To do what some one else has done, or as nearly like it as we can, and to make one thing look like another, embraces an astonishingly large part of all our activities. The tendency to imitate the candle with our most modern light sources has been often commented on in these columns. The tendency is at least entitled to the veneration due to age. No sooner had the oil lamp been raised to a position of marked superiority over the candle as a light source, by the invention of the glass chimney and the central draft wick, than inventors, with the same perverted ingenuity that is displayed to-day, began to construct lamps to imitate candles. These imitations assumed all three forms of lighting fixture—the table lamp, the bracket and the chandelier.

Fig. 5 shows a candelabrum, or double candle stick, in which the oil reservoir forms part of the central standard.

Fig. 6 shows an elaborate and beautiful wall bracket designed to support these oil burning, imitation candles.

According to contemporary reports these imitation candles were quite as popular in their day—the latter part of the eighteenth century—as are their electric imitations of the present time.

A valuable or startling discovery invariably starts a train of investigators, as well as imitators, to work along the same lines. Perhaps it is only a variation of the universal instinct of imitation that prompts us to seek for ourselves where others have found. The discovery of the first nugget of gold in California was the signal for the instant march thitherward of a hoard of gold seekers from all parts of the world. Roentgen's marvelous revelation of invisible rays immediately attracted a host of other scientists. And no sooner had one tungsten lamp ap-

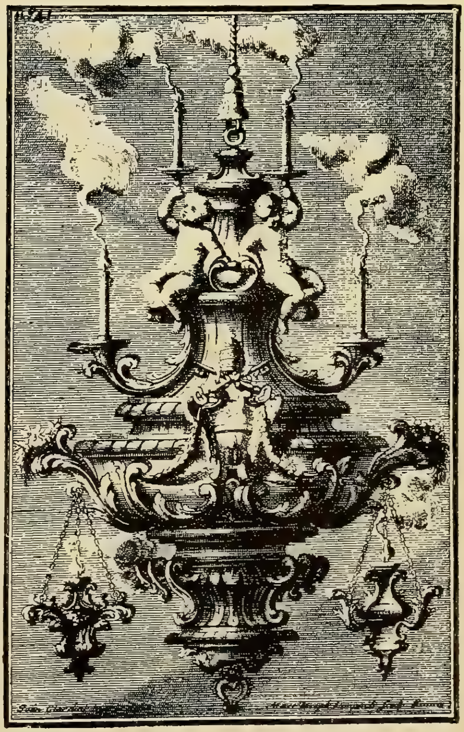


FIG. 7.—ELABORATE OIL LAMP CHANDELIER.

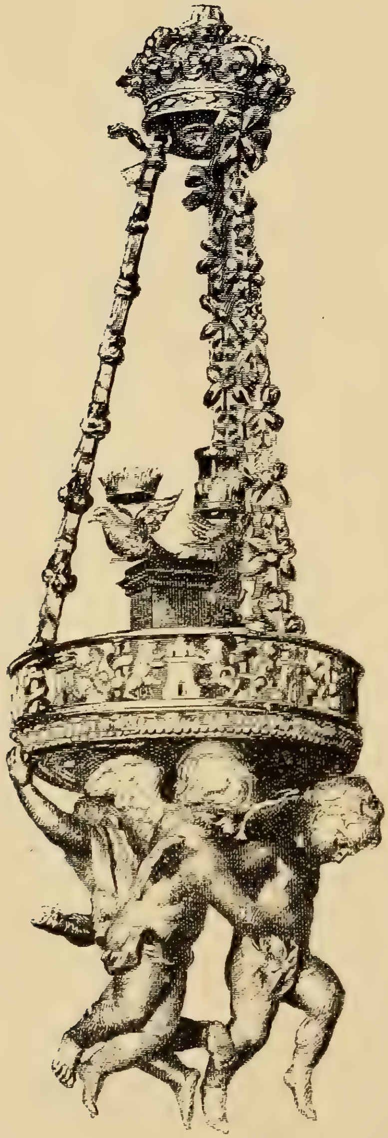


FIG. 8.—OIL LAMP CHANDELIER IN CATHEDRAL OF SEVILLE.

peared than others began to spring up in all quarters, like mushrooms after a rain. The power of suggestion probably has something to do with this tendency; but this question belongs rather to the Society for Psychical Research than to the Illuminating Engineering Society. At any rate Argand's invention acted like a lighted string in a pack of fire crackers and new conceits and inventions in lamps made each its own little noise in the world in quick succession. Those were the halcyon days of the oil lamp. Art and craftsmanship, as well as invention, lent their aid to its glory, and the masterpieces then constructed have served as models for imitators unto this day.

Fig. 7 shows a lamp chandelier designed for church illumination by Jean Giardin.

Fig. 8 is a similar chandelier made for the cathedral of Seville.

Whether a thing is great or small depends wholly upon the unit by which it is measured. The poor little oil lamps of the eighteenth century cut a sorry figure indeed measured against our modern light sources, which seem to us magnificent achievements of science. Perhaps a century hence we shall look with quite as great disdain upon the flaming arc and pressure gas lamps of to-day.

But, however much our present light-sources may be improved upon, or superseded, there is little likelihood of the luminous flame ever being wholly supplanted. It contains too much of attractiveness in itself and has too long a record of human interest to ever admit of its complete extinction. We can hardly conceive of an arc lamp ever being hung up in the future for sentimental reasons of association; when it is finally superseded by the better source which is sure to be found sooner or later it will remain only a museum curiosity. But the oil lamp and the candle seem fair to exist forever; custom and sentiment are more vital elements in human history than either science or commerce.

The Business Side of Modern Street Illumination

By G. Brewer Griffin and F. H. Dimock.

The thoroughly aroused interest in the betterment of street lighting in the United States is a distinct presage of improved conditions. It also brings encouragement to the efforts of electrical engineers who have made illumination an especial study and creates an incentive for greater attention to the practical elements of the subject on the part of general practitioners, or consulting engineers, who have hitherto considered it too lightly.

The efforts of The Illuminating Engineer with its able editorials and interesting papers on the subject, the space given to the question in the leading electrical publications at home and abroad, the work of Dr. Louis Bell and the growing number of well-considered papers on this branch of our profession brought before electrical societies emphasize the importance of the matter; but there remain many who would minimize the value of investigations such as those of Mr. W. C. Allen, and there still exist among those allied to the profession, or of influence with its clients, some who believe with the short-visioned contributor to the *Electrical World* of January 21, 1909, that an illuminating engineer is of little use.

Within the personal cognizance of the collaborators in this paper are instances of consulting engineers of the highest standing in other fields who have been in positions where unexpected requirements in their official advisory capacity made apparent to them their neglect of the practical considerations affecting open air illumination in its dynamics and economics.

It is to such former apathy that we may primarily ascribe the present acknowledged condition of inferiority to our foreign cousins in this particular field. That fact needs neither discussion nor emphasis. Every progressive community is either aware of it or being awakened. When the more aggressive individuals of municipalities have realized its importance to the extent of contributing from their private purses toward installations of the most expensive type that advert to public benefit, as has been done in several of our cities within the last year, and consider it money well spent, the more obtuse will soon realize that their encounter is with a condition rather than with a theory.

The majority of the street lighting plants of our country are out of date in either equipment or capacity. Extension, remodeling, alteration or condemnation and substitution is a certainty.

Many of the old plants were put in with the best facilities considered available, but often under incompetent advice. Considerations of first cost were all important and the factors of efficiency and consequent ultimate economy were too little understood or weighed.

It has been advanced, as a plausible reason for the situation as compared with that in Germany, England and France, that if *labor* and material were on such a basis with us that impregnated carbons or composite electrodes of equal quality were procurable at foreign prices, our cities would not be subject to such invidious comparisons in certain particulars. This is scarcely tenable when statistics show that London, Berlin and Paris pay respectively $100, $126 and $166 per arc per year, or double the cost of highly efficient and satisfactory service in some of our cities.

These foreign centers have gone extensively into experiment, have been in advance of us in some instances in number and effective disposition of lights in certain areas, and have utilized principles and devices little tried here until recently.

The question as to wisdom of principle, economy and real efficiency of some of these recent developments or systems is still open to discussion. In the light of the cost of maintenance above mentioned, their systems are not to be at once generally adopted by our communities.

The papers and articles in which this question in its recent developments have been discussed are ample as to theory and estimate. Details of construction, photometric tests, calculations and theoretical

economy have been so covered that it seems unnecessary to elaborate such particulars; but brief reference to the claims for photometric, practical and economic efficiency of the types now prominent is pertinent for comparative purposes.

It has seemed to us that in all of the discussion, and even in the publications of the great manufacturers, we have seen little of *actual results*. There have been many articles on "cost of operation" of different lamps, but they have seemed to be based on estimate, experiment, partial figures or widely differing methods of accounting.

An ideal solution is the desire of all; but the *business side must be the dominant factor in the majority of cases* brought to our consideration.

Many believe, and among them are a large number of city fathers and laity, that, as in our former naval policy, we can afford to await the result of the costly experiments of our neighbors across the water and profit by their experience; but a large and constantly increasing number of situations is continually bringing to engineers those who say:

"Public sentiment demands better service.

"The old plant is inadequate.

"Our tax rate is high and our borrowing capacity limited.

"Our community is growing and we must cover more territory.

"What is our best plan?"

It has seemed to us that as a supplement to the several proposed plans we should give thorough consideration to facts obtainable. From an unusual opportunity for observation, it is our purpose to present for consideration in solution of such a problem a summary of complete comparative data as to cost and efficiency of an admirably managed plant in one of our larger cities, where *efficiency* and *capacity* have been greatly *increased, with actual decrease in operating cost,* within the past few months.

The data compared are for four corresponding months of last year and this. The figures are official, from public records and readily accessible, and should have a material bearing on the important question.

The system used is distinctly American in its utilization of mercuric rectification of alternating currents; and the figures as to actual saving in operating expense in fuel and labor while supplying a greater number of lamps, with better illumination, should be interesting. As now operating, the service may be largely increased before the old limit of boiler capacity, fuel consumption, etc., and consequent appropriation is reached.

In this discussion the tungsten lamp will not be considered. For specific purposes it has admirable qualities, and for highway illumination in outlying districts and parks, where a low unit intensity of illumination is sufficient, it is well adapted. It is practically safe to predict that for general use in business sections, where traffic is heavy and practically continuous through many hours of darkness and high unit intensity with uniform distribution is the prime requisite, the best type of arc lamp will be the standard for many years to come.

A sufficient number of tungsten or metallic filament incandescents to supply the required unit intensity of illumination could not be installed and maintained for anything approaching the cost of arc lamp equivalent.

The arc lights worthy of present consideration are:

1. Enclosed arc series A. C.
2. Enclosed arc series D. C.
3. Flaming carbon arc (impregnated).
4. Carbone type arc.
5. Regenerative flame.
6. Mercury rectified metallic flame.

All of these but the Carbone lamp have been described in The Illuminating Engineer and the details need not be repeated. The day of the open arc has passed, and the same may now be said of series alternating and direct current enclosed arcs for new installations for street lighting, excepting for specific purposes. Up to the introduction of the metallic flame arc, the direct current series enclosed arc lamp had become generally regarded, all things considered, as the most desirable type for outdoor service, and the number of plants throughout the country using this system is very great, the majority of generating stations delivering alternating current with auxiliary constant current distributors. It is these in-

stallations that must be newly equipped.

The necessary betterments usually involve the following requirements:

1. Substitution for lamps now in use of others of higher efficiency.

2. Changes in auxiliary distributing apparatus for delivery of increased service without greater (and usually decreased) demand upon boiler capacity and fuel consumption or hydraulic power supply; and consequent result of:

1. Increase of number of lamps available for either extension of area served or provision within the old district of more lights of greater unit intensity, or installation at more frequent intervals of lamps of the same unit intensity as before.

2. Saving in current cost per lamp.

These conditions and results for an old plant may well be considered in determining new installations.

It may be regarded as settled that the pure carbon electrode has reached its highest development in the enclosed arc lamp. The last word in that field is the attempt with the "Carbone" type, wherein ordinary carbons are inclined toward each other, as are the impregnated carbons of the flaming arc lamp, and the arc maintained in a magnetic field which deflects it into a long flame. As a resultant of the exposure of both the crater of the positive carbon and the white tip of the negative the light given is superior in intensity to that of open and enclosed arc types with vertical carbons.

The color of the light is white, but the shape of the distribution curve is similar to that of the chemical impregnated carbon flame arc, the maximum of intensity being downward, and for that reason its application is limited to a particular field. It is also to be noted that its operative principle produces an abnormally long non-luminous arc, with consequent waste of energy.

The carbon flaming arc has many recent advocates, some of whom may have been influenced by its extensive use abroad and others by its apparent intensity.

Its photometric curves show a high candle power, but its value should be otherwise weighed.

Later in this paper will be given comparative curves of the different lights, but at present we will refer only to its salient features with reference to practical efficiency and economy, the business standpoint.

But for the apparent neglect of this principle by some advocates, it might seem a truism to state that the desired goal should be the utmost good to the greatest number of the public. The object to be striven for in street illumination is "visual usefulness," which is far better contributed toward by steady light of comparatively low volume with uniform distribution than by intermittent successions of intense light and comparative shadow, necessitating constant readjustment of the eye to the varying conditions. Whether one be driving or walking, whether traveling at a rapid pace or a slow one, the strains upon the optic nerve of frequent transitions from light to shade are harmful and differ only in degree. Accepted measurements of the carbon flame arc establish its maximum intensity as distributed downward, maintaining a practically even photometric value from 50 to 90 degrees from the horizontal, which must result in successive alternations of light and shade with ordinary intervals of installation.

From a business standpoint, the value of its high candle-power efficiency must be measured with regard to these features in conjunction with the fact that the high light intensity depends upon the temperature of the arc. The high temperature

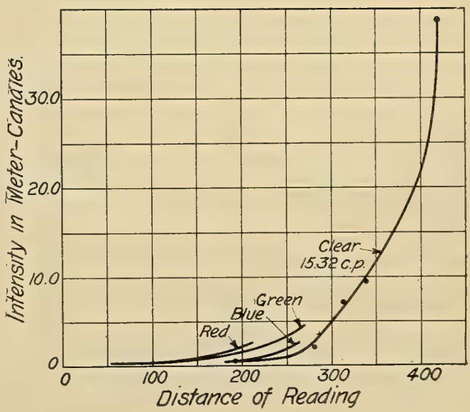


FIG. I.—VARIATION OF VISUAL ACUITY WITH COLOR.

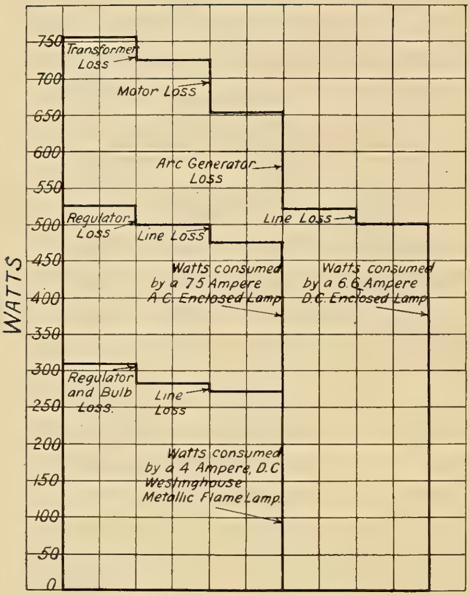


FIG. 2.—POWER CONSUMPTION PER LAMP IN THE SEVERAL DIVISIONS OF SERIES ALTERNATING AND SERIES DIRECT CURRENT ENCLOSED ARC IN COMPARISON WITH THAT OF MERCURY RECTIFIED METALLIC FLAME LAMP.

necessary for the luminosity attained necessitates open burning conditions, or adaptation of forced draft, with consequent rapid consumption of carbons, wherefore life is sacrificed for intensity.

The third factor to be taken into account is, like the first mentioned, optical and physiological. In that respect, it may not appear at once as having particular bearing upon the business side of the matter until it be remembered that true economics must be based upon public welfare, and that money spent in disregard of such consideration is money wasted.

The trend of contemporary attention to this fact makes especially interesting the investigations now being conducted at Columbia University by Professor Sydney W. Ashe in the field of physiological effects of light and color. His papers should be of especial interest to the student of illumination and the results must be considered commercially. While his investigations are in progress we may appropriate from his papers a diagram (Fig. 1) indicative of the relative physiological values of lights of different colors.

In view of the claims urged by advocates of the flame arc light in favor of its beautiful amber or orange color much might be said; but the subject was so ably commented upon in the editorial columns of the *Electrical World* of February 25 last that we venture to quote:

"The practically important conclusion is that even for low intensities, variations from approximate white do no particular good and may do harm, while at any reasonable working intensity white is ordinarily to be preferred for reasons quite independent of acuity. The long and short of it is that the human eye has been developed for daylight, and while it is tolerant of the wide range that daylight really covers, it was never organized for the utilization of freak illuminants, and is more than likely to resent their intrusion."

The regenerative flame arc lamp has been described in THE ILLUMINATING ENGINEER and its features have been summarized as giving a high candle-power intensity with claimed elimination of the noxious fumes which preclude the use of other than pure carbon arcs indoors.

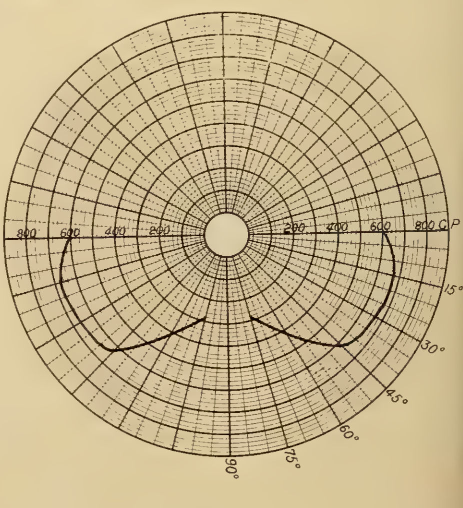


FIG. 3.—DISTRIBUTION CURVE, WESTINGHOUSE D. C. SERIES METALLIC FLAME LAMP. AVERAGE CURVE OF 12 READINGS AT 20-HOUR INTERVALS. TERMINAL WATTS 272, AMPERES 4, ARC VOLTAGE 68, M. L. H. C. P. 600, WATTS PER M. L. H. C. P. .455.

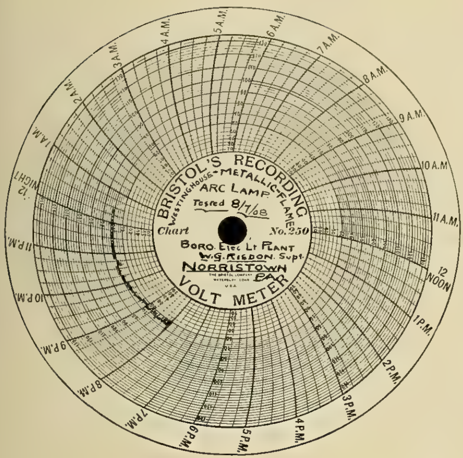


FIG. 4.—VOLTMETER RECORD, WESTINGHOUSE D. C. METALLIC FLAME LAMP, NORRISTOWN, PA., AUGUST 7, 1908.

From a business standpoint, the economic efficiency given by its advocates is not attractive and the light has the color characteristics of the usual carbon flame arc.

In observation of the practical working of the metallic flame arc lamp we have found real benefit from actual service which seems worthy of attention. The features which are prominent include:

White light.
Admirable distribution.
Adaptability to existing plants.
High efficiency.
Low amperage and wattage.
Long life of trim.
Low maintenance cost.

Fig. 2 is a graphic representation of the wattage and comparative losses between primary alternating current generators and lamp terminals of the series enclosed arc lamps in general use and of the metallic flame, all lamps covered by this chart having the same approximate illuminating values.

The saving is obvious. The loss of energy in the series direct current arc lamp nearly equals that required for each metallic flame lamp operated from a mercury rectifier.

Fig. 3 is the distribution curve of a metallic flame lamp plotted from readings taken at intervals of twenty hours during the life of one trim, which in this instance was 242 hours.

Fig. 4 is a reproduction of an actual voltmeter record from a lamp of the mercury rectified direct current metallic flame type tested at the Borough Plant of Norristown, Pa., by its superintendent. The regularity of maintained pressure is both remarkable and typical.

The next and much-to-be-considered result of our investigations is the report of actual operation of the installation earlier mentioned.

The admirable accounting methods of the managers of this plant give practical value to the comparative figures.

(*To be continued.*)

High Life in Electric Signs

BY T. I. JONES.

There is certainly no other spot on the American continent, and but few in the world, where there is such a continuous tread of feet throughout the entire twenty-four hours of the day as at the intersection of Broadway and Forty-second street, New York City. It is here that Seventh avenue intersects Broadway at a sharp angle, cutting off a small triangle, on which stands the magnificent Times Building, and forming another triangle to the north, which has long been known as Longacre Square, but is now called Times Square, apparently by common consent. This is the very heart of the theatre district, the Metropolitan Opera House, the original home of grand opera in this country being within two blocks. Two of New York's finest hotels are located in the immediate vicinity, and there are restaurants, cafes, rathskellers and places of refreshment of every description. Longacre Square is also the northern terminus and culminating point of the famous "Great White Way."

Between business by day and pleasure

FIG. I.

by night this section throbs with human life unceasingly, only varying somewhat in intensity at the different hours. It is the metropolis in epitome. Here those that stand highest in the social scale of the country touch elbows with the most obscure and abandoned. From the most luxurious cafe you have but to turn a corner to find the cheapest "beannery"; and only a brick wall may separate the reveller squandering his patrimony on priceless wines and viands from the cartman snatching a five cent cup of coffee and an egg sandwich.

Wherever men congregate there will the advertising sign be found. Perhaps it has never occurred to you to ask what makes the "Great White Way" white? The answer is plain: *the electric sign.* The public lighting along this famous stretch of thoroughfare is very ordinary indeed, but the passing throng has given such an enormous value to the advertising sign that every available space is occupied to the full. A more definite idea of the value of these spaces for advertising purposes will be conveyed by the statement that the rental for space for a single large electric sign ranges from $1000 to $1500 a month. Added to this is the expense of installing the sign and maintaining it, which includes cost of electric current, lamps and attendance. Thus, the yearly cost of one of these signs would make a very respectable income for a business in a smaller city or town.

The art and ingenuity displayed in many of the electric signs in this section is nothing short of marvelous. Motion, color, design, size all are utilized to the limit in the attempt to produce a startling and impressive effect.

One of the prettiest of these is shown in Fig. 1. The effect of running water in the fountain is heightened by the use of color. The sign contains 1400 lamps.

Fig. 2 shows one of the most recent and most novel effects ever attempted in electric sign work. The small lamps in the background flash so as to imitate falling rain. The skirt actually flutters in the wind, an effect impossible to convey in a

FIG. 2.

FIG. 3.

picture, while the words of the sign alternately appear and disappear. A beautiful blending of colors is also used.

Fig. 3 shows a comparison of the illuminated signboard and the sign that is luminous in itself. The size of the signboard can be judged by comparing it with the stores below. Each section of this board is lighted with a single tungsten lamp in a metal reflector enameled white on the inside. The glove sign above is an exceedingly clever use of both the luminous and reflecting principles. The glove is outlined in minute lamps, and is not only painted to imitate satin, but is worked into relief, so that the perspective and peculiar gloss of the satin make it exceedingly realistic. Note the size of this sign by comparison with the store fronts below.

Fig. 4 shows another equally ingenious and fascinating effect. This sign occupies the northern side of the triangle forming Longacre Square, and is probably in the most conspicuous and most valuable location of any sign in the world. It can

FIG. 4.

be seen far down Broadway, and is particularly conspicuous from the intersections of both Seventh avenue and Broadway with Forty-second street. It seems slightly incongruous that such a realistic effect should have been lavished upon so common a drink as ginger ale. Champagne would have been much more befitting the location and the expense. The three upper views show the three stages through which the sign passes. At the left the sign is shown in its simplest form. The next represents the drawing of the cork, the lines issuing from the mouth of the bottle, being rapidly flashed, give the idea of outward motion. Immediately following this there is a peculiar flashing of miniature lamps, which gives an exceedingly realistic simulation of the foam bubbling out of the bottle. The daylight view in the lower side shows the advantages of the location, and the intricate steel structure supporting the sign. Three thousand lamps are required in this masterpiece of spectacular lighting.

In view of the enormous amount of money represented by these signs, the question will naturally suggest itself, do they pay? Without attempting to ascertain exact figures, the question may be answered at once in the affirmative from the simple fact that they continue not only to be used, but to increase in size, elaboration and cost; and those who are footing the bills are assuredly not investing their money for the amusement of Broadway crowds, but for profits in real money on the resulting business.

Street Lighting in San Diego, Cal.

By C. E. Groesbeck.

The move for better street lighting, which was spread over the entire country during the past two years, came in from the West, like the weather. The Pacific Coast was the leader in the movement, one city after another taking it up in

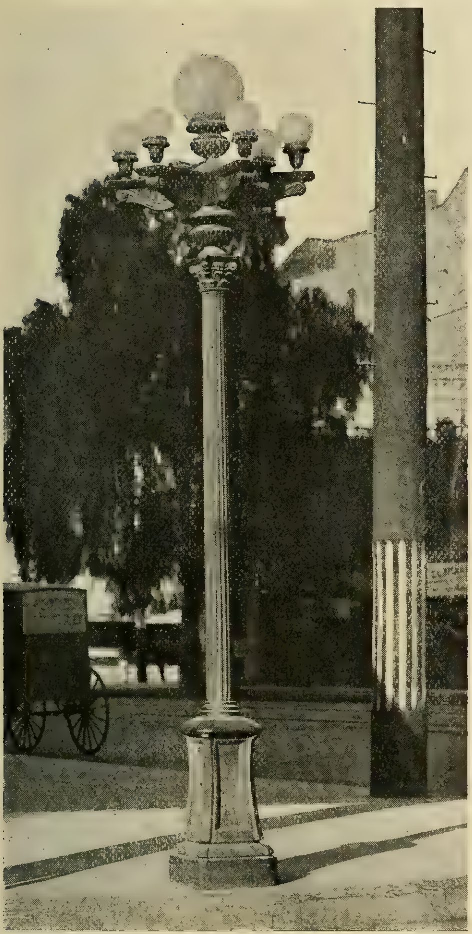


FIG. 1.—TYPE OF ORNAMENTAL LAMPPOST USED IN SAN DIEGO, CAL.

quick succession and with remarkable enthusiasm.

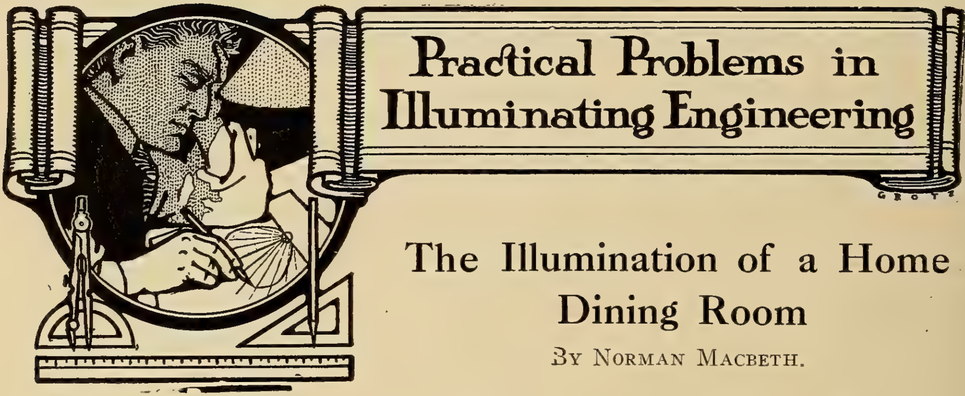
San Diego must be counted among these enterprising cities. The character of the installation may be fairly judged from the illustration shown. The lamp standard is particularly handsome and elaborate. Six of these standards are placed in each block 200 ft. in length, and eight on the 300 ft. block. Ninety-six are now in service, and 200 more are being installed. The lamps are lighted from dusk until midnight each night, the property owners along the thoroughfare paying the cost of lighting. Each standard carries six 16-candle power carbon filament lamps and one 32-candle power lamp in the large central globe. Twelve watt series tungsten lamps run in multiple from a transformer attached to the base of the post are being tested. The illumination, as well as the installation, is very satisfactory—so much so that the property owners and merchants along all of the busy streets are taking means to have similar installations made at the earliest possible date.

While the design of the lamp standards is open to criticism from the purely utilitarian standpoint, owing to the obstruction offered to the upright lamps by the rather massive arms supporting them, the distinctly decorative effect of the installation fully compensates for this slight loss in illumination, at least in the opinion of the merchants from whose private purses it is installed and maintained. The merchant realizes that the looks of his store are not to be neglected, and if this is true of his store it is equally true of the street on which his store is located.

The fact that this installation is being put in from private funds calls to mind the numerous other cases in which similar action has been or is being taken. This fact is of wider importance than may first appear. If the lighting of business streets in an adequate manner is justly chargeable to those owning property or doing business on such streets, why may not other matters of an equally public nature, such as pavements, be just as properly charged to the same sources? Unquestionably a modern street lighting equipment adds to the business of the merchants on the street, but as surely as it adds to trade, it adds to the value of the property, and therefore to the revenues of the city received through taxation.

Furthermore, to increase the value and attractiveness of the business section of a city is to add to the value of the city as a whole. Thus every citizen becomes a participant in the advantages accruing from private enterprise.

Public spirit and private enterprise are by no means antagonistic, and in this particular instance have worked together for good, and the ultimate good that is bound to result from better street lighting is far beyond the mere temporary advantage of the few merchants and others whose foresight has outrun public enterprise.



The Illumination of a Home Dining Room

By Norman Macbeth.

Residence dining rooms can probably be more easily and effectively illuminated than any other room in the home; but, notwithstanding the simplicity of the problem, the effectiveness of the installation can be, and in very many instances is, very seriously impaired by using fixtures which are entirely unfitted for the purpose. The opinion has been expressed that careful attention to the lighting of the dining room will result in more pleasure to the occupants than may be derived from the illumination of any other room in the house.

The illumination of the dining room shown in Figs. 1 and 2 has been the subject of much favorable comment, and has rarely failed to arouse the enthusiasm of guests, the climax apparently coming with the announcement that the source is an inverted incandescent gas lamp.

Fig. 1, a night photograph, does not convey a proper impression of the illumination of this room. The dome, which is the only light source used, is made of amber, green, rose and ruby colored art glass, and practically all of the light transmitted by these colors to the side walls and ceiling is non-actinic, so that, while these parts of the room are satisfactorily lighted when judged by the eye, these colored rays are of no value on a photographic plate. This may be noted by observing the detail shown in the lower left hand corner of Fig. 1, where the dark rug is lighted directly from the under part of the dome, and the light wall paper, shown in the rectangular space in the center of this photograph, between the china cabinet and the door, receives transmitted light only; the rug appears to be of a lighter color than the paper. By reference to these same sections in the daylight photograph, Fig. 2, where the tones are given more nearly their correct weight, the above point may be appreciated.

Illumination measurements were taken on a horizontal plane at the table height, for the purpose of determining the intensity effective on the table when it is

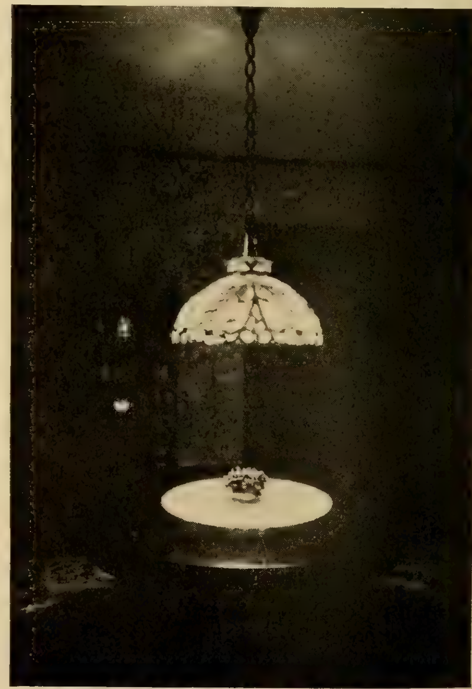


FIG. 1.—NIGHT VIEW OF THE DINING ROOM.

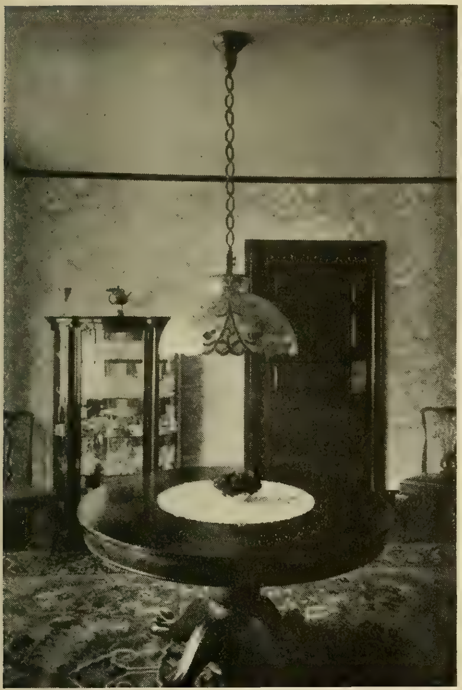


FIG. 2.—DAYLIGHT VIEW.

used as shown in the photographs, or when extended to a greater length. Measurements were also taken on the wall and ceiling to show the increases in illumination at these points, due to light reflected from the table when it was more or less covered with linen.

The proper height at which to place the dome was made the subject of a thorough investigation, as was also the proper reflector to be used within such a dome. In Fig. 3 the position of the eye of a person seated at the table is shown, at the right hand, when sitting upright, and at the left when leaning somewhat forward. It will be seen that a person at one side of the table can plainly see over the top of the heads of those seated opposite, and at the same time neither the mantle nor the reflector can be seen, unless one leans far forward and purposely looks up. Placing the dome higher would bring the full glare of the mantle into the eyes, while lowering it would cut off the view of those on opposite sides of the table.

The relative positions of the lamp and reflector within the dome is such that the vertical angle, from the center of the mantle to the lower edge of the dome, was as small as could be secured, thus permitting the location of the dome at the highest point above the table without violating that more important consideration —keeping the lamp out of the direct line of vision; that is to say, having the lamp and all sources of high intrinsic brilliancy entirely above the lower edge of the dome when viewed from any position around the table.

SUMMARY OF INSTALLATION.

Dimensions of room, 12′ 10″ x 13′ 10″.
Height of ceiling, 9′ 0″.
Height of table, 2′ 5″.
Height of lower edge of dome, 4′ 6½″.
Height of dome above table, 2′ 1½″.
Height of mantle above table, 2′ 11″.
Number of mantles used, 1.
Nominal consumption cubic feet of gas per hour, 3.3.
Pressure during test, in inches water, 3.8.

Illumination measurements were made on a horizontal plane 29 in. high (table height) at 1 ft. distances, from the side wall to directly beneath the lamp, and at intermediate stations 5 and 13, beyond the latter being where the illumination falls off abruptly, due to the edge of the dome cutting off all direct rays.

The values given below for stations 1 to 9 are the averages of the two sets of readings taken at right angles, indicated in Fig. 4.

The mantle was the original one fitted to this lamp, and had been in use regularly for over six months; no adjustments

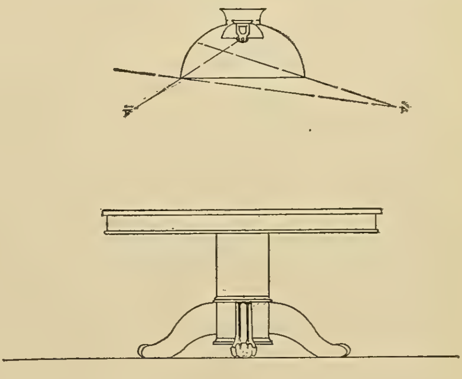


FIG. 3.—POSITION OF THE EYE OF A PERSON SEATED AT THE TABLE.

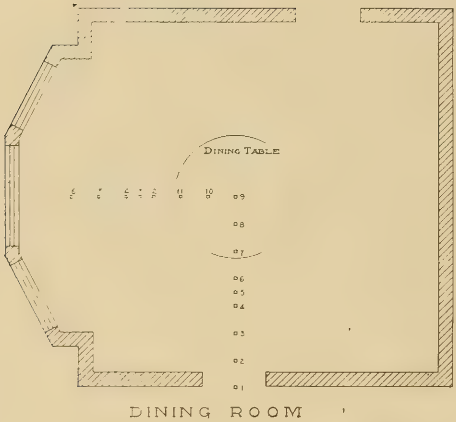


FIG. 4.—PLAN OF STATIONS.

were made of the lamp, nor were changes in pressure noted during any of the tests. These were as follows:

No. 1, alabaster cylinder only.

No. 2, half-frosted cylinder only.

No. 3, prismatic distributing reflector with half-frosted cylinder.

No. 4, opal distributing reflector with half-frosted cylinder, the results of which are given in table No. 1.

The distribution with the prismatic reflector is shown to be somewhat more uniform than that with the opal reflector.

The appearance of the dome was somewhat better with the opal reflector than with the prismatic; the main objection, however, was due to greater depth of the latter when used with this dome, which would bring the lower edge of the prism glass in the line of vision.

Using the dome without a reflector resulted in an unequal and excessive illumination of the art glass, detracting very considerably from its appearance.

In table No. 2 are given the stations, angles, intensity in foot-candles and the apparent candle power, the latter calculated from the horizontal illumination.

Fig. 5 is the polar distribution curve of the inverted incandescent gas lamp with half-frosted cylinder, opal reflector and art glass dome, and is somewhat interesting, as the distance from the center of the mantle to the photometer screen was but 2.91 ft.

The illumination, as measured on the walls and ceiling, with mahogany table, without covering, shows an average intensity of approximately .2 foot-candles. With the table partially covered with doilies the illumination was increased 210 per cent., and with a table cloth the increase was 520 per cent., resulting in approximately 1.25 foot-candles effective on the walls and ceiling, both of which, from a decorator's standpoint, would be classed as light, the walls being a very light gray and the ceiling a light tint, nearly white.

TABLE NO. 1.

Test No.	1	2	3	4
Station No.	Alabaster cylinder only. Foot-candles.	Half-frosted cylinder only. Foot-candles.	Distribut'g prismatic reflector with half-frosted cylinder. Foot-candles.	Distributing opal reflector with half-frosted cylinder. Foot-candles.
1	.09	...	...	...
2	.13	...	.14	.13
3	.16	.16	.22	.21
4	.39	.35	1.16	.61
5	1.03	1.53	2.95	2.33
6	2.33	2.8	4.53	4.30
7	4.15	5.5	9.2	8.50
8	5.95	9.05	15.78	15.80
9	7.00	12.5	17.95	24.28

TABLE NO. 2.

Station.	Angle. Deg.	Min.	Foot-candles in	Apparent candle-power.
9	0		24.28	207
8-10	19		15.8	159
7-11	34	20	8.85	133
6-12	45	40	4.3	107
5-13	50	0	2.33	74.6
4-14	53	40	.61	24.8
3	59	30	.21	13.4
2	64	0	.13	13.4

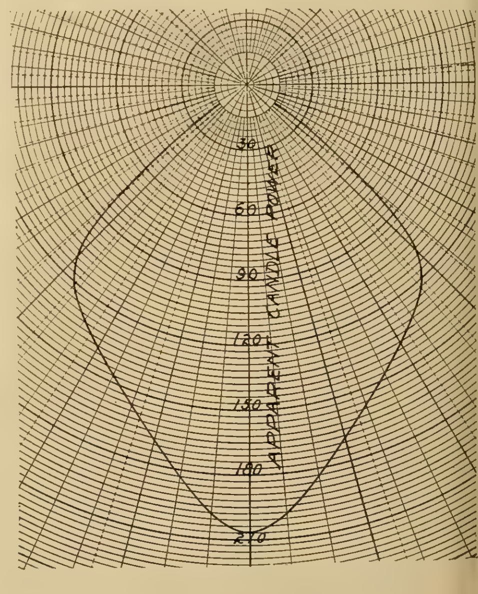


FIG. 5.—POLAR DISTRIBUTION CURVE.

FIG. 1.—THE TAILOR SHOP.

The Lighting of a Tailor Shop

BY R. W. PIERSON.

As a solution to the problem of lighting the tailor shop, which was published in the August number, the following is submitted, together with cost as compared to that using Nernst lamps, which was given in the September number.

It is now pretty generally accepted as correct that for a room with medium dark walls and ceiling, tungsten lamps equipped with prismatic reflectors will produce an average illumination of 4 foot-candles per watt expended per square foot, or 1 foot-candle intensity requires .25 watts per square foot.

Although the writer is of the opinion that 5 foot-candles is a sufficiently high intensity for a tailor shop, in order to make this solution comparable with the Nernst, the same conditions will be observed—6 foot-candles average intensity; electricity at 10 cents per kilowatt and 100 hours use per month.

The area is 20 x 40 ft., or 800 sq. ft., which would require 800 x 6 x .25 = 1200 watts, or 1.2 kw.. Twelve 100 watt tungsten lamps make the most satisfactory division.

An average life of 800 hours per lamp makes the maintenance 1.5 cents per lamp, as in New York, where this shop was stated to be, the electric light companies are supplying tungsten lamp renewals in 100-watt size for $1 each.

The total cost per kilowatt hour is, therefore, 10 + 1.5 = 11.5 cents.

Twelve hundred watts, or 1.2 kw. $\times$ $0.115 $\times$ 100 hours makes the cost for maintenance and energy $13.80 per month. The initial cost, using distributing type prismatic reflectors, at $0.95, list price, will be 12 $\times$ (1.00 + .95) or $23.40.

The plan Fig. 2 shows the arrangement of outlets, Nos. 1, 2, 3 and 4 being single lights hung about 9 ft. from the

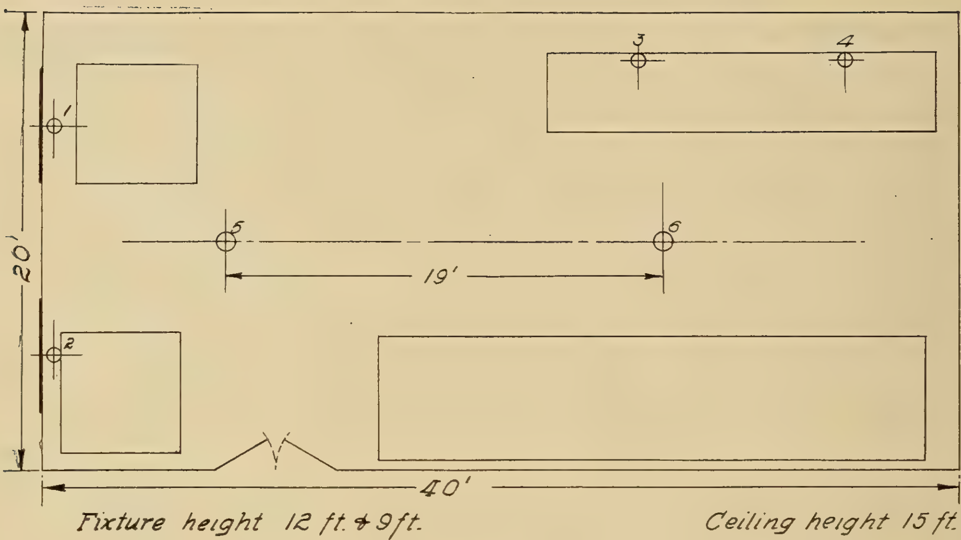
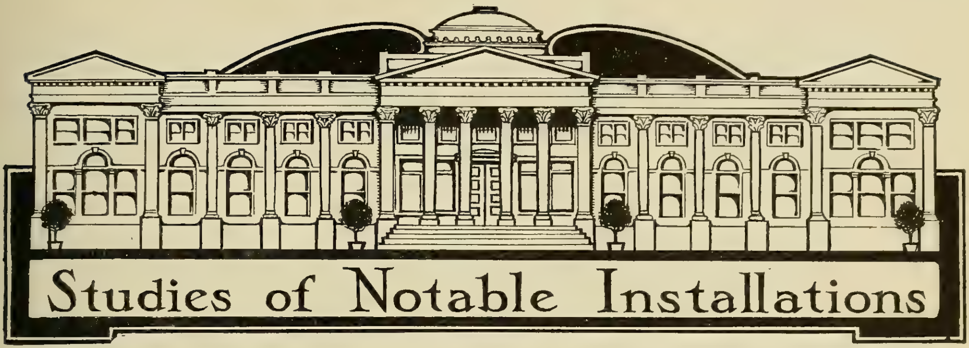


FIG. 2.—PLAN FOR OUTLETS.

floor, while No. 5 and No. 6 are four lights each, and should be 12 ft. from floor to center of lamps. In the photograph (Fig. 2) two lamps are shown, in front of either window, and since these appear to be for display purposes, we can but assume that the proprietors wish for such effects. Outlets No. 3 and No. 4 are shown as over the back edge of the cutting table, as in this position shadows are practically eliminated, the light from the fixture at outlet No. 6 being sufficient to overcome any shadow on the side toward the center of the room.

It will be evident that the cost for wiring and fixtures will be far less than for the solution using Nernst, though no estimate can be given in either case. The initial cost (lamps only) is, however, (\$37.13 — \$23.40) = \$13.73 lower, and the cost for energy and maintenance is (\$15.25 — \$13.80) = \$1.45 less per month, or 10½ per cent. per month saving on operating costs alone.

ABSORPTION AND REFLECTIONS



The Carnegie Trust Company, New York

The name attached to this institution would in itself convey the impression of large financial responsibility and proportionate dignity and elegance in the quarters which it would occupy. The former impression may be dismissed with a simple affirmative answer; the latter may especially hold our attention while we examine the lighting installation.

The home of this financial institution is on the ground floor of the new portion of the Trinity Building, on Broadway, in the heart of the financial district. This structure is one of the most beautiful of its kind in the city. As the portion of the building first erected faces Trinity church-yard, the architects wisely gave a Gothic impress to its architecture. A fair idea of the magnificence of the structure may be obtained from the illustration shown in Fig. 1, which is a view of the interior, looking toward the entrance, which is on Broadway. The floors, wainscotings and walls are of marble, the decorations consisting of Mosaic borders. The woodwork is of mahogany and the railings of solid bronze. In costliness of material and beauty of finish nothing beyond this could be devised short of the use of the precious metals. Greater elaboration could, of course, be employed, but only at the expense of the dignity and grandeur of the effect.

The lighting installation here shows for itself. The panels of the ceiling contain very simple fixtures without glassware, frosted lamps being depended upon for diffusion. The side brackets are likewise simple in design, with an attempt to preserve the Gothic motif.

Fig. 2 shows one of the private offices. The general illumination here is from the lamps placed at the top of the partition. Special illumination for the desk is furnished by a simple drop cord supporting an ordinary key socket, and a 16 candle power lamp, on which is hung apparently a tin reflector. The cost of the entire apparatus should not exceed 75 cents. Furthermore, it is hung above the middle of the desk, so that the light of the lamp can shine directly into the eyes of the person seated at the desk and give direct reflection from the paper. This is surely a curious anomaly, and an impressive example of what may be so often found, *i. e.,* the cheapest kind of a lighting fixture amid the most elegant and expensive furnishings. Looking past this make-shift desk lamp, which would hardly be tolerated in the average kitchen, we see a solid bronze partition, polished mahogany woodwork, and inlaid marble.

Fig. 3 shows the private office of the president of the institution. The lighting installation here is only a continuation of the anomaly shown in Fig. 2. There is a central chandelier of the simplest and most conventional design, which can be bought from the stock of any fixture concern for from \$5 to \$10. This is fitted with four ordinary electric lamps, with cheap glass reflectors, which do not in any way protect the eyes of those in the room. The side brackets are placed regardless of symmetry, or apparently any other motive than probably convenience in wiring. They can be purchased in the open market for about \$2 each. To each of these has been attached an additional

FIG. 1.—ENTRANCE TO CARNEGIE TRUST COMPANY, NEW YORK.

FIG. 2.—ONE OF THE PRIVATE OFFICES.

FIG. 3.—PRESIDENT'S PRIVATE OFFICE.

bare lamp. The only saving grace in the whole office is the table lamp, which is a choice piece of art, but of comparatively little use as a source of light.

Fig. 4 is a view in the safe deposit vaults. No fault can be found with the illumination here, which is of a utilitarian order, but well devised, consisting of lamps placed in the ceiling and covered with shallow diffusing globes.

A curious question in regard to this installation that must at once suggest itself is, how did this happen? Who is responsible, and how does it come that those in possession of the premises do not appreciate the incongruity? It seems almost impossible that an architect capable of designing such a harmonious and exquisite interior as this, or that those responsible for the furnishings, which are unexceptionable, could pass over without protest the installation of such grotesquely inadequate lighting fixtures. If this were a single peculiar exception it would be easier to explain, but it is not; it is only one case among thousands. Moreover, it is recent, the building being not more than two years old. The illuminating engineer has been frequently warned to keep his hands off the sacred domain of the architect in matters of fixture design, on the ground that, being an engineer, he cannot possibly have any sense of the artistic fitness of things. But so long as prodigies of impropriety, such as are here shown, continue to exist, not only will the professional illuminating engineer, but any one who has the opportunity, be justified in making such vigorous protest as lies within his power.

Another pertinent question suggested by this example is the extent to which the illuminating engineer should presume to advise on the artistic side of a lighting installation. It is not impossible that illuminometer measurements taken in this case would show a passable degree of general intensity; certainly with the use of a few desk and table lamps no inconvenience would be felt by employees. If,

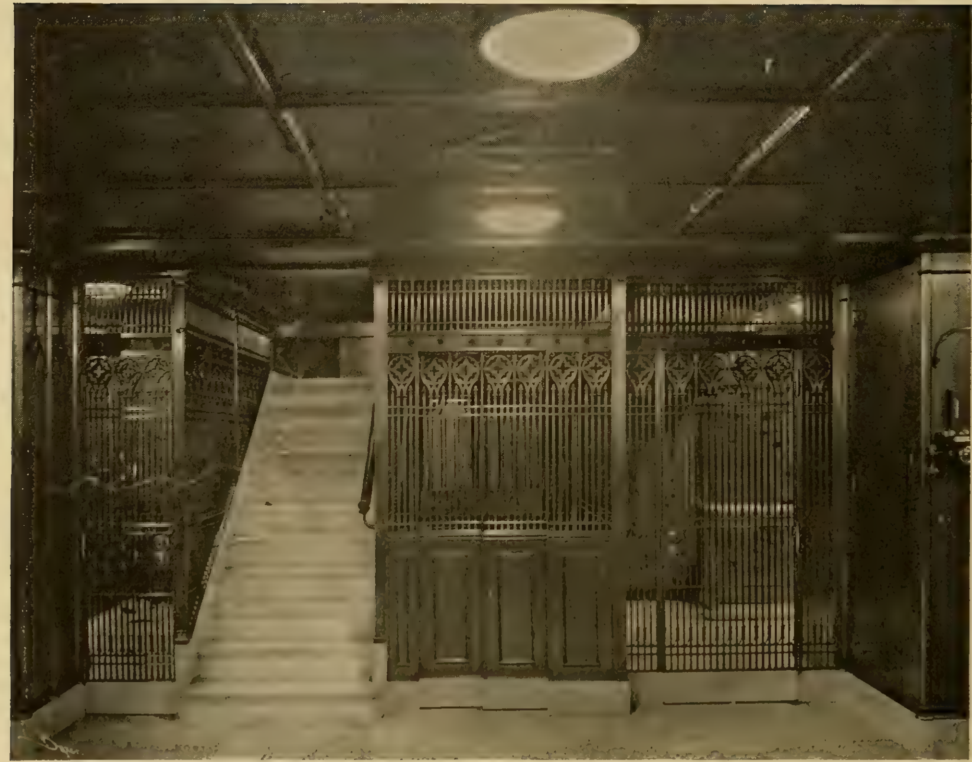


FIG. 4.—ENTRANCE TO THE SAFE DEPOSIT VAULTS.

however, the fixture installation were indicated, it would be a sad reflection upon the taste and intelligence of any illuminating engineer to say that he would not perceive the incongruity.

A consideration of all points leads to the usual conclusion, namely, that satisfactory results can only be assured by the mutual co-operation of owner, architect, illuminating engineer and electrical engineer. Even though all of these parties may do their particular duties independently, the combined result may be inadequate or unsatisfactory. When it comes to be understood that the duties of the architect and the several classes of engineers with whom he has to deal are simply different parts of the building, as much as the material and construction, and that harmonious results can be obtained only by proper co-ordination, such anomalies as the one herewith illustrated will cease to bear testimony to the contempt for illuminating engineering.

The Relation of the Architect to the Illuminating Engineer

By Albert Wahle.

In presenting this paper for consideration I am guided solely by a desire to impress upon the illuminating engineer that, in my opinion, the co-operation of the architect is absolutely necessary in planning the lighting in all building operations. The problem, as it appears to me, is, How shall you present your qualifications so as to warrant serious consideration on the part of the architect to-day?

The method to be used is open for extended views, and I am in hopes through this means of bringing about such a broad and general discussion by the architect and engineer as will eventually suggest a course resulting in this very necessary co-operation.

The illuminating engineer represents a field practically new in the professional world, but unlimited in its scope, embodying the economical and efficient lighting of all building operations. There are individual illuminating engineers who to-day are recognized by the architect; but all ought to be as a body, and it is the latter condition which I consider the serious phase of your future. There is no question that the illuminating engineer represents a profession already established (and possibly without any specific aid of the architect), but in my opinion along utilitarian lines. Your profession warrants a greater future than that represented by commercial requirements, and although you must be practical, it is absolutely necessary that you go further and apply your knowledge of what is proper for an efficient lighting result to the æsthetic, as established by the architectural profession. Your profession does not differ materially from others in being primarily a commercial proposition; yet there can be no question of its importance as representing a field for development of a great scope, but necessarily limited to those who realize their opportunities.

I have no desire to appear in the role of a champion, but I have been for a number of years in close touch with architects in all sections of this country and I assume to know, to a great extent, their ideals. I have been strongly impressed with their genuine enthusiasm for that which is artistic and appropriate, the earnestness with which they insist upon this at all times, regardless of conditions, and the consideration given to the individual who has demonstrated his qualifications in any given capacity. There are exceptions to this, as in all professional walks, but there can be no question that architecture embodies practically a thorough knowledge of every industry connected with building operation, representing innumerable details requisite in planning and supervising the erection of buildings, monumental or otherwise. It is true that architects have the assistance of the artisan and engineer in all branches, yet they unquestionably are the moving spirit and establish the basis for that for which they assume entire responsibility.

This, then, represents a profession that covers the entire field of art; for although the structural part of any building is an absolute necessity, yet it only forms a groundwork, or background, for the application of art in all its branches. I feel, therefore, that this is the natural field wherein the illuminating engineer must look for a future, and it lies entirely within your province to convince the architect

that you are a necessary adjunct in designing the lighting in all building operations, which unquestionably is one of the important factors in a general result.

Now it occurs to me that when an illuminating engineer assumes the responsibility of planning the lighting (I will say, for example, in the drawing room of a residence or the counting room of a bank) he must thoroughly appreciate, or at least make an effort to learn, the character and requirements of the room; and when he allots a number of outlets he should have in mind the form of fixture requisite, or, in any event, what distribution of outlets will insure an efficient lighting system, in the form of fixtures or brackets, or both, that will fit decoratively and therefore be a necessary part of the room or rooms. I do not mean to imply that you must be an authority on art to qualify as an illuminating engineer, but you cannot apply the same rules that govern a commercial proposition to the types I have given as an example; and when you are consulted in the capacity indicated by your profession, your first duty should be to determine an appropriate lighting source, and if not competent to judge, then have the architect indicate (if only in a general way) what his ideas are, which will enable you to establish a light-source that will conform to the requirements.

With this as a basis, you then have an opportunity to apply your science, economically and efficiently. There are cases where efficiency is not a serious consideration and where a pleasing result is a factor; but here again the architect must guide you. This course if persistently followed will eventually make it possible for you to assume this added responsibility, so necessary to a successful result.

It has become a common occurrence to hear the architect (as also the fixture manufacturer) censured for a poor result, when, as a matter of fact, the engineer had sole power to establish a basis that would result harmoniously, but failed utterly to grasp the requirements beyond furnishing light; or, to be more specific, simply provided sufficient candle power to insure light, but to all appearances had no conception of what would be proper as a light-source. I make this statement guardedly and without a spirit of criticism, knowing thoroughly well that the co-operation I have in mind does not or at least has not existed except in a limited way. This condition cannot continue, as the demand for lighting results that embody an application of the arts to your science has become a crying need and must receive the serious consideration of your profession as a body if you want the censorship of the architect and fixture manufacturer, which some of your have already assumed, taken seriously.

There can be no excuse for poor lighting results. You have at your disposal high-efficiency lamps that unquestionably will develop to a still higher plane, and you have auxiliaries in various forms that tend to an increased efficiency—a combination that can be applied to any result, æsthetically or otherwise. You also have as a criterion innumerable examples of buildings of all classes, showing varied ideas or forms of lighting, that can always be considered as a basis for good or bad. Furthermore, you have the better element of the fixture manufacturing industry that you can look to for assistance in any form requisite.

However, I strongly contend that the architect combines every element necessary to your profession, and which, if cultivated, will establish you on a plane that will assure recognition and, consequently, co-operation of the architectural profession. I have no desire to appear arbitrary in my views; on the contrary, I want them considered as suggestive, although they represent the result of close observation of conditions with which I have been in contact during the last few years.

Indirect Lighting Fixtures

However illuminating engineers may disagree as to the proper use of indirect lighting, all must agree that it has a field for which it is particularly adapted. The design of fixtures for this method of illumination therefore becomes a matter of importance from the decorative and architectual standpoints.

FIG. I.—COMBINATION DIRECT AND INDIRECT LIGHTING FIXTURE.

The accompanying illustrations show two very successful efforts in this direction. Fig. 1 is a combination fixture arranged for either direct or indirect illumination, or both. The central bowl is finished with a reflecting surface on the inside, and arranged to receive a tungsten lamp, the light of which is thereby reflected to the ceiling, and so diffused through the space below. Attached to this bowl by graceful and well proportioned arms are direct lighting units. The proportions have been well worked out; and as the central bowl has an evident purpose when in use, shown by the light emanating from it, as if it were itself filled to overflowing with luminous rays, it has an artistic reason for being.

This combination is ingenious, as well as artistic. The fixture is especially calculated for private dining room illumination. It suggests at once that while the meal is being partaken of, the direct lighting may be used, thus giving a degree of brilliancy on the table desired, according to the size of lamps used. When the repast is succeeded by the "feast of reason and flow of soul," the direct lighting may be turned off, leaving only the mild radiance of the indirect illumination.

Fig. 2 at once strikes the eye with its graceful outline and logical method of suspension. The metal can be given any desired finish to harmonize with the surroundings, while a reflector of the most efficient type may be readily contained within the bowl, which, as in Fig. 1, will thus become a fount of light. If the metal were given a hammered or *repoussé* effect the fixture would be particularly suited to the den or cosey corner. Both designs are meritorious, and show genuine progress in adapting fixtures to modern methods of illumination.

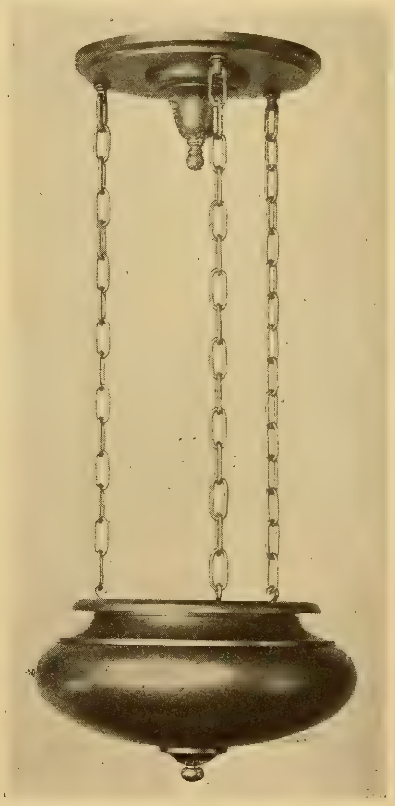


FIG. 2.—INDIRECT LIGHTING FIXTURE.

Theory and Technology

A Portable Photometer for Measuring the Intensity of Street Lighting Sources

By George C. Shaad.

FIG. I.—GREEN & REPPERT PORTABLE PHOTOMETER.

A practical photometer of a portable type may be readily constructed for use in measuring the intensity of street lighting sources when a standard photometer screen of the Bunsen or Lummer-Brodhun type is available. Such an instrument was recently constructed by Messrs. Green and Reppert, senior students in electrical engineering at the Massachusetts Institute of Technology, for use in their thesis investigations of street lighting in Boston. Many of the particular features of the instrument here described are due to the suggestions of Dr. Louis Bell.

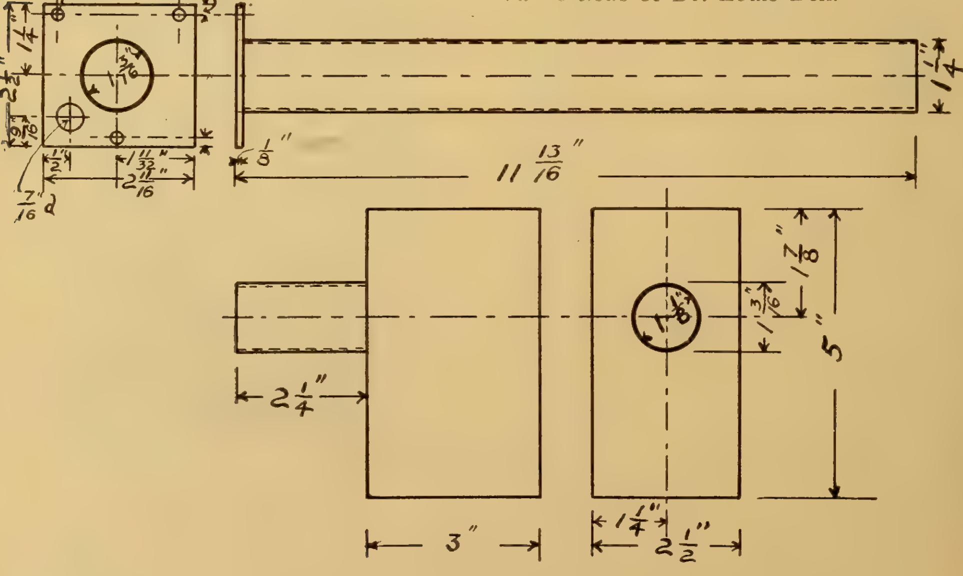


Fig. 2.

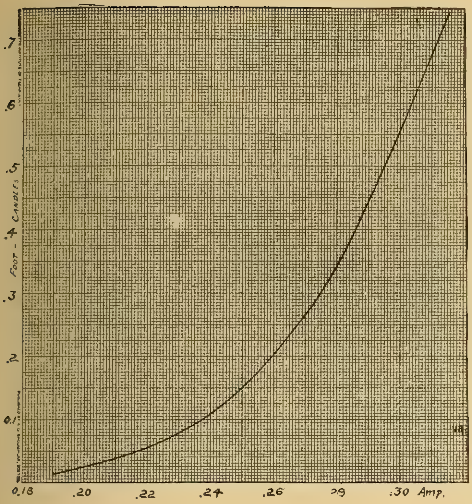


FIG. 3.

Fig. 1 shows a photographic view of the photometer as used by Messrs. Green and Reppert. A standard Lummer-Brodhun photometer screen was fitted with two tubes of the dimensions shown in Fig. 2. One end of each tube was fitted with a brass plate and these plates were clamped together over the photometer screen by means of bolts and winged nuts. The outer end of one tube, the one to be pointed toward the light source, was left open, and the second tube was fitted with a brass box for holding the standard lamp. All the extra fittings were coated with flat black paint and the photometer was mounted in a block fitted to an ordinary tripod. Sights were attached to the tubes in order to aid in the directing of the instrument toward a light source, and a protractor and plumb line were used for determining the angle at which the photometer was set when a reading was taken.

A miniature tungsten lamp was used for the standard source of light and the strength of the standard was varied by controlling the amount of current flowing in the lamp. This necessitated the use of a storage battery (six volts), a rheostat admitting of close adjustment, and an ammeter. Some difficulty was experienced in obtaining a suitable standard lamp but two four-volt, 1 c. p. tungsten units (bulb dimensions 1 in. in diameter and 1⅜ in. long), properly aged, were obtained from the National Electric Lamp Association and proved very satisfactory. The instrument was calibrated in the laboratory by mounting it at known distances from a standard light source and reading the current in the instrument lamp when the photometer screen was just balanced. The current required by the lamp to balance a known illumination of the screen was thus determined and a calibration curve plotted. Fig. 3 shows such a calibration curve.

At the low current values there may be some trouble on account of the color of the standard lamp, and from the calibration curve it is seen that as the current in the lamp is increased the setting of the photometer is not so sensitive. For these reasons it would be desirable, if the instrument were to be used for a wide range of intensity of illumination of the screen, to have more than one size of standard or to arrange the tube so that the standard could be mounted in different positions with reference to the screen. A separate calibration curve for each standard and for each position of the standard would be required.

The error introduced by light reflected from the inner walls of the tube was investigated and found to be negligible when the light source was at a distance of 10 ft. from the screen. When the light source was mounted 5 ft. from the screen an error in the neighborhood of 3 per cent. was detected, the illumination of the screen being increased by this amount.

A suitable rheostat for use with the 1 c. p. standard was constructed of 65 ft. of Ia Ia wire, No. 24, in series with 65 ft. of No. 23 German silver wire, both cotton covered, wound in a single layer upon a wood ring (5 in. internal diameter and 7 in. external diameter) and fastened in place with shellac. A movable spring contact was arranged to bear on the wire, the insulation being scraped from the wire at the point of contact.

The Daylight Efficiency of Artificial Illuminants

By Herbert E. Ives.

Among students of illumination it is generally agreed that the best light for human use is daylight. Therefore the nearer an artificial light approaches daylight in color and distribution the higher it should rank. There has been developed, however, no simple means of measuring an artificial light source in such manner that a numerical value can be given to its approach in quality to daylight. In other words there has been no basis for estimating the "daylight efficiency."

In so far as color is concerned progress has recently been made along two lines which should make possible and profitable an attempt to supply this deficiency. On the side of physical research extended series of spectrophotometric measurements of daylight have been made, notably by E. L. Nichols. On the technical side there have been developed new illuminants of high efficiency, and of color considerably nearer daylight than those previously known.

The present investigation was prompted by the question whether it might not be possible, with some of the more efficient illuminants, to imitate daylight by the use of properly colored globes or screens, without lowering the resultant efficiency below that of some of the older sources. Knowing the spectral relation of a source to daylight, it is a simple problem to determine the spectral absorption necessary to reduce the light to daylight color. Knowing the intensity equivalent of the different colors of the spectrum, it is possible to determine the loss in intensity due to the use of the colored absorbing screen.

The problem up to this point is an entirely practical one. After having worked out some numerical values in the way described below, it occurred to the writer that the white light obtained in this manner might be used as a convenient measure of the quality of an artificial light. The ratio

$$\frac{\text{Intensity of available white light}}{\text{Total intensity of source}}$$

offers itself as a measure of the illuminant's efficiency with regard to color.

In the following paper are given the results of applying this idea to a number of the more prominent artificial illuminants. Two methods are developed: the first method, suggested above, by a discussion of absorbing screens, applicable to sources with a continuous spectrum, and giving the actual available non-selective white light; the second method, by means of the primary color sensations, applicable to both selective and non-selective sources, and giving the amount of white sensation, in general only partly or not at all available.

First Method.

White Light Efficiency as Obtained by the Discussion of Absorbing Screens.

If we assume the intensity of the daylight spectrum to be unity at all points, the spectral intensity of any other light, as determined by the spectrophotometer, may be plotted on such a scale that the lowest point of the resultant curve is also unity. The colored screen which in combination with the source will transmit light of daylight color is the one whose percentage transmission at each point of the spectrum is the reciprocal of the ordinate of the illuminant's spectral curve. The first step in the artificial production of daylight by this method is therefore the determination of the spectral relationship of artificial sources to daylight. For this purpose is available the work of E. L. Nichols on average daylight in terms of the acetylene flame.[1] Average daylight, as determined by Nichols, has the following intensities throughout the spectrum as compared with acetylene equality being assumed, according to the usual practice at 59μ.

$.725\mu$	$.620\mu$	$.590\mu$	$.530\mu$	$.460\mu$	$.420\mu$	$.390\mu$
.450	.865	1.00	1.34	2.07	2.59	2.63

Other light sources may be compared in the spectrophotometer with acetylene, and hence with daylight.

[1] Transactions of the Illuminating Engineering Society, May, 1908.

Measurements of several illuminants—gas, glow lamps, etc.—are given in the paper referred to. The electric glow lamps are not, however, specified according to watts per candle, the only exact mode of specification where relative color values are to be considered; and the Welsbach mantles are not classified according to cerium content, which determines the color. The writer, therefore, thought it worth while for the purpose of this paper to make spectrophotometer measurements against acetylene of carbon, tungsten and other glow lamps at the exact watts per candle at which each is rated for commercial comparison, and of a Welsbach mantle whose cerium content is known.

The carbon and tungsten lamps were measured for watts per mean horizontal candle, and were 4 and 3.1 for the carbon, 1.25 for the tungsten. The mean spherical values were obtained by the use of reduction factors. The metalized and tungsten lamps were measured directly for mean spherical candle power on an integrating photometer. The Welsbach mantle contained ¾ per cent. cerium, being the mantle recommended for residential illumination by the Welsbach Company.

The measurements were made with a Zummer-Brodhun spectrophotometer; a tungsten lamp at constant voltage served as comparison source, and the substitution method was used. Special care was taken to exclude the effect of scattered light at the ends of the spectrum by the use of colored glasses between the eye and eye-slit. Measurements were carried to $.67\mu$ in the red and to $.42\mu$ in the blue.

The results of these measurements are given in tables I. and II., table I. in terms of acetylene, table II. in terms of "average daylight," assuming the daylight-acetylene ratios determined by Nichols.

It will be observed that if we plot as curves the data of table II. the lowest point of all the curves is in the blue. In order, therefore, to determine the appropriate absorbing screens these curves must be drawn with a point in the extreme blue made equal to unity. The choice of this point is largely arbitrary. The shorter the wave-length chosen the smaller the percentage transmission of the absorbing screen for the other portions of the spectrum. A point should, therefore, be chosen of as long a wave length as possible without too great a loss of blue light. In the present paper the "equality point" has been taken as $.42\mu$. This is one of the points measured in

TABLE I.

Spectrophotometer Measurements of Various Artificial Light Sources Against Acetylene.

Source.	.42	.45	.50	.55	.59	.62	.65	$.67\mu$.
1. Glow lamp, carbon, 4.85 watts per mean sph. cp.	.445	.550	.700	.875	1.00	1.10	1.19	1.26
2. Glow lamp, carbon, 3.75 watts per mean sph. cp.	.495	.595	.735	.885	1.00	1.09	1.17	1.23
3. Glow lamp, metallized, 3.1 watts per mean sph. cp.	.560	.655	.780	.905	1.00	1.06	1.13	1.17
4. Glow lamp, tantalum, 2.6 watts per mean sph. cp.	.595	.680	.810	.920	1.00	1.05	1.12	1.15
5. Glow lamp, tungsten, 1.58 watts per mean sph. cp.	.785	.815	.875	.945	1.00	1.03	1.09	1.11
6. Acetylene	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7. Welsbach mantle, ¾% cerium	1.28	1.40	1.42	1.22	1.00	.86	.71	.64
8. Mercury arc (Nichols)		$.4358\mu$ 16.81		$.5460\mu$ 3.75		$.5780\mu$ 1.00		

TABLE II.

Light Sources Compared with "Average Daylight."

Source.	.42	.45	.50	.55	.59	.62	.65	$.67\mu$.
1. Glow lamp, carbon, 4.85 watts per mean sph. cp.	.171	.250	.438	.718	1.00	1.27	1.65	1.97
2. Glow lamp, carbon, 3.75 watts per mean sph. cp.	.191	.265	.460	.730	1.00	1.25	1.63	1.93
3. Glow lamp, metallized, 3.1 watts per mean sph. cp.	.216	.295	.485	.750	1.00	1.23	1.56	1.83
4. Glow lamp, tantalum, 2.6 watts per mean sph cp.	.231	.310	.504	.759	1.00	1.22	1.54	1.80
5. Glow lamp, tungsten, 1.58 watts per mean sph. cp.	.303	.375	.546	.780	1.00	1.19	1.47	1.70
6. Acetylene	.386	.455	.622	.825	1.00	1.16	1.38	1.56
7. Welsbach mantle, ¾% cerium	.495	.640	.884	1.00	1.00	1.00	.98	.98
8. Mercury arc (Nichols)		$.4358\mu$ 7.85		$.5460\mu$ 3.00		$.5780\mu$ 1.00		

FIG. I.—CURVES SHOWING AMOUNT OF SPECTRA OF VARIOUS LIGHT SOURCES WHICH MUST BE ABSORBED TO GIVE WHITE LIGHT. SHADED AREA—WHITE LIGHT.

Nichols' daylight investigation and is the point beyond which the average daylight curve takes more nearly the slope of the usual artificial sources. When screened from this point the deficiency in blue sensation of any of the ordinary sources is less than 2 per cent., a quantity small enough to be considered negligible. A different choice of equality point will, of course, lead to numerically different results, a matter to be treated again in the discussion of the second method.

In Fig. 1 the data of table II. are plotted on this basis. The area of each curve above the shaded area represents the portion of the illuminant's spectrum which must be removed by absorption to reduce it to identity with the daylight spectrum. The colored glass to effect this is one whose transmission is the reciprocal of the ordinate of the curve in question at each point.

Having obtained the properly colored glass to effect the absorption, we now wish to know the intensity value of the resultant artificial daylight. This we shall compare with the intensity of the unscreened source. We do this by considering the intensity value of the different spectral colors and the resultant loss in total intensity when the various portions of the spectrum are reduced in the proportion indicated above. The method is indicated in Fig. 2. The shaded area represents the spectrum of white light expressed in terms of luminosity; it is, in other words, the sensibility curve of the normal eye.[2] The areas enclosed by the outlined curves and the axis of abscissæ are the resultant of increasing the ordinants of the sensibility curve in the proportion indicated by the curves of Fig. 1. The areas of the outlined curves are, therefore, proportional to the intensity of the unscreened sources, the shaded area to the intensity of the white light remaining after screening. The

[2] Abney, Philosophical Transactions of the Royal Society, Vol. 193, p. 286, 1900. This curve is for high intensities where the Purkinje effect is not noticeable.

TABLE III.

Color Sensation Values, White Sensation, and White Light Efficiencies.

	Source.	Sensation. Red.	Green.	Blue.	Hue.	Luminosity.	White sens.	White sens. eff.	White light eff.
1.	Glow lamp, carbon, 4.85 watts per mean sph. cp.	46.5	39.7	13.8	.588μ	44.1	13.7	31.0	19.3
2.	Glow lamp, carbon, 3.75 watts per mean sph. cp.	45.9	39.4	14.7	.588	43.5	14.5	33.4	21.2
3.	Glow lamp, metallized, 3.1 watts per mean sph. cp.	44.8	39.7	15.5	.585	42.9	15.3	35.8	24.6
4.	Glow lamp, tantalum, 2.6 watts per mean sph. cp.	44.2	39.8	16.0	.585	42.6	15.9	37.3	26.2
5.	Glow lamp, tungsten, 1.58 watts per mean sph. cp.	42.8	39.1	18.1	.584	41.5	18.0	43.5	33.2
6.	Acetylene	40.8	38.3	20.9	.583	40.1	20.7	51.7	42.0
7.	Welsbach mantle, ¾% cerium	37.4	37.8	24.8	.577	37.4	24.5	65.5	50.5
8.	Mercury arc (Nichols)	22.4	23.6	54.0	.480	23.0	18.0	78.5	
9.	Daylight	33.3	33.3	33.3	...	33.3	33.3	100	100

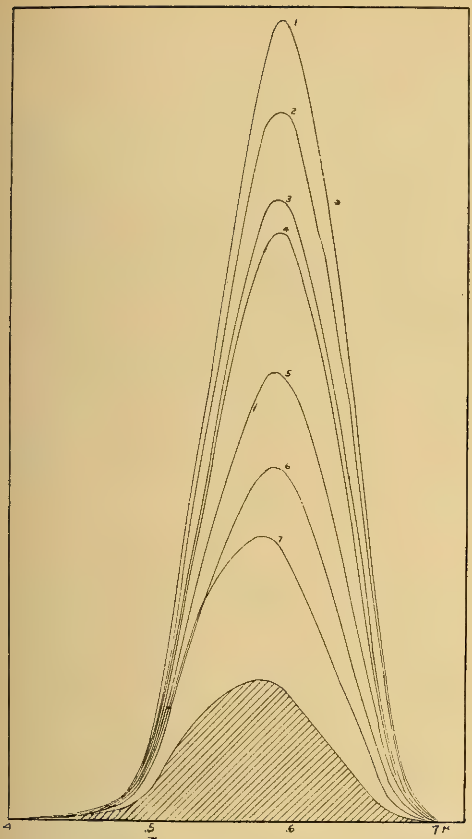


FIG. 2.—EXCESS OF COLORED LIGHT IN VARIOUS LIGHT SOURCES REPRESENTED IN TERMS OF INTENSITY.

ratio of the shaded to the unshaded area gives the value

$$\frac{\text{Intensity of White Light Obtained by Screening}}{\text{from } .42\mu \text{ Intensity of Unscreened Source.}}$$

This quantity, for which the values for several sources are given in table III., column 6, is an indication of the loss in efficiency which may be expected upon producing artificial daylight by the use of colored absorbing screens. The figures also lend themselves to giving a value to a light source considered from the standpoint of its approach in color to daylight. They may in fact be called the "daylight" or "white light efficiencies," as is here done.

In table IV., column 3, the results are applied to the electric glow lamps in combination with their energy consumption, giving what may be called "white light watts per candle." It will be observed that the question which prompted the investigation is answered. The "white light watts per candle" of the tungsten lamp is less than the watts per candle of the "four watt" carbon lamp, indicating that artificial daylight should be no more expensive than was electric light not long ago. This, of course, assumes the possibility of obtaining colored glass of exactly the absorption required.

TABLE IV.

Watts Per Mean Spherical Candle of Electric Glow Lamps.

	Ordinary.	White sensation.	White light.
Carbon	4.85	15.6	25.1
Carbon	3.75	11.2	17.7
Metallized	3.1	8.6	12.6
Tantalum	2.5	6.7	9.5
Tungsten	1.58	3.6	4.7

This method of obtaining efficiency in terms of daylight, namely, by the use of colored absorbing screens, is of more practical than scientific interest. As has been pointed out, the numerical values will vary with the wave-length chosen as the equality point. A method giving a relationship to daylight independent of choice of co-ordinates would in some ways be preferable. Moreover the above method gives the value zero to selective sources, where by selective sources is meant one of the type of the mercury arc whose spectrum consists of bright lines with no continuous background. Selective sources, however, actually excite all three primary color sensations, giving some sensation of white. The attempt to find a method applicable to such sources has led to a second method of finding color efficiency, namely, the method by color sensations, which will now be described.

Second Method.

White Light Efficiency Obtained by Means of the Primary Color Sensations.

Any color can be matched by a mixture of white light and one ray of the spec-

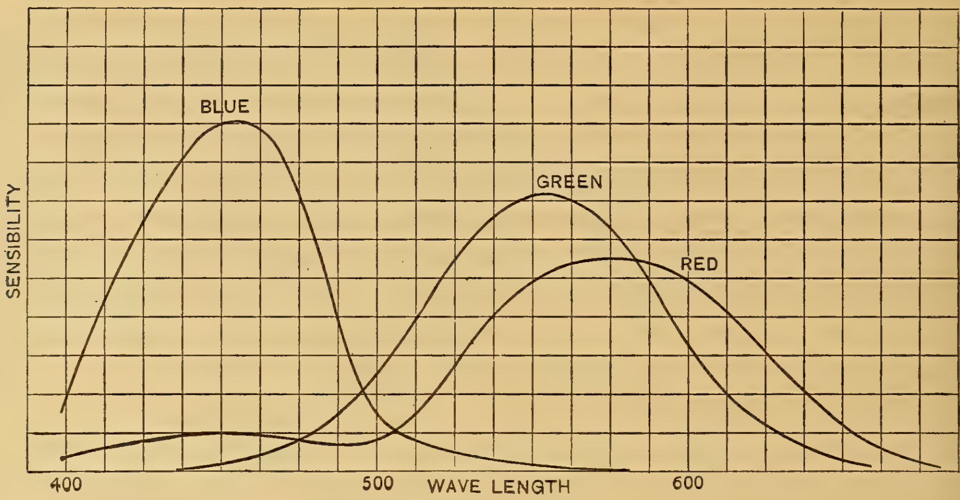


FIG. 3.—COLOR SENSATION CURVES, ACCORDING TO KOENIG AND EXNER.

trum.[3] The intensity of this white compared with the intensity of the colored source gives a white light efficiency which is obtainable with all types of selective and non-selective sources. We may imagine this accomplished experimentally in the following manner: Given a standard white light, let the intensity of the source in question be measured against the standard, say with a flicker photometer or by some other method independent of color difference. By means of a spectroscopic device superpose on the white light colored light from a narrow region of the spectrum. Alter the intensity of the white and the wave length and intensity of the spectral light until a visual match is obtained for both color and intensity. The ratio of the intensity of the white used in this match to the intensity of the source is a white light efficiency, independent both of the character of the source and of any arbitrarily chosen "equality point."

The experimental difficulties in the way of carrying out the procedure as outlined are great, chiefly because of the difficulty of producing a white light standard. The whole process may, however, be carried out indirectly by means of the color sensation curves of the normal eye as determined by Koenig. These curves, as modified by Exner,[4] are reproduced in Fig. 3. They show the amounts of each of the primary sensations—red, green and blue—which are excited by the various portions of the spectrum. They are drawn, according to the usual convention, with the three areas equal for white light. White then being equal excitation of the three sensations, all other colors can be expressed in terms of the relative proportions of red, green and blue sensation. Knowing the sensation values of a color, it is then possible to find from the curves a wave length which, with white added, has the same proportionate parts of red, green and blue as the color. In this manner the dominant hue of the color is determined and the amount of white light to be added to the dominant hue. It is then necessary to have the intensity values of the three sensations. Applying these to the color and then to the white added to the dominant hue, the desired ratio of intensities may be obtained.

In order to apply this method it is necessary to know the sensation values of a color and the luminosity values of the three sensations. To obtain the sensation values of a color two procedures are open. If spectrophotometric measurements are

[3] Abney, "Color Measurement and Mixture," chapter XIII. The only exceptions are furnished by colors of purple hue, in which the green sensation is smaller than either the red or the blue. These must be measured in terms of their complementaries. Purple light sources are not met with in ordinary experience and so need not be considered.

[4] F. Exner, Sitzungsberichte der Akademie der Wissenschaften, Wien, Vol. III, p. 857, 1902.

available the sensation values may be obtained by multiplying the sensation curve ordinants at each wave length by the spectral intensity of the color as compared with the standard. A second method is to measure the color by means of a color mixing instrument the sensation values of whose colors are known. In the latter method we again meet the difficulty that no standard white light is available. In the present investigation the sensation values were obtained by applying the spectrophotometer values obtained above to the sensation curves. As to the luminosity values of the sensations Abney[5] has determined that for sunlight the values are:

Red.	Green.	Blue.
65.73	33.83	.44

These values are used in the present paper on the assumption that they will be substantially the same for average daylight.

To illustrate the method of procedure the work for acetylene is given in full. Applying the values of table II. to the sensation curves the sensation values (that is, the areas of the new curves, measured with a planimeter) found for acetylene were:

Red.	Green.	Blue.
84	88	48

Giving to each sensation its appropriate luminosity value, the luminosity of the acetylene color (in arbitrary units) was 92.1. By trial it was found that if 47.6 parts of white were subtracted from the color the remaining sensation values, *i. e.*, 46.4, 40.4, .4, were in the proportion of the sensations at $.583\mu$. The luminosity or intensity ratio is, therefore,

$$\frac{47.6}{92.1} = 51.7,$$ and the dominant hue is $.583\mu$.[6]

This white light efficiency is obtainable for any type of source—for instance, the mercury arc—the values for which, calculated from spectrophotometer figures given by Nichols,[7] will be found in table III., along with values for the sources already evaluated according to method I.

Comparison of the white light efficiencies obtained in this way with those from the first method shows that in every case the second efficiency is higher than the first. It is clear why this should be so, for if we call the intensity of the white light obtained by the first method I_w, we have that the total color I_c (expressing it in intensity units) is equal to I_w plus the absorbed wave lengths represented by the curve of Fig. 1 above the shaded area. This absorbed color is itself, not being a single spectrum ray, reducible to white light, say I_{w2} and a single wave length. We may express this fact in the following equation:

$$I_c = I_{w1} + I_{w2} + I^{\lambda} = I_w + I^{\lambda}.$$

I_w represents the total white sensation; I_{w1} represents the available non-selective white light; its value may be zero, as in the mercury arc.

The two kinds of white light efficiency or color efficiency may be conveniently designated as "white sensation efficiency" and "white light efficiency," the first being always larger than the second.

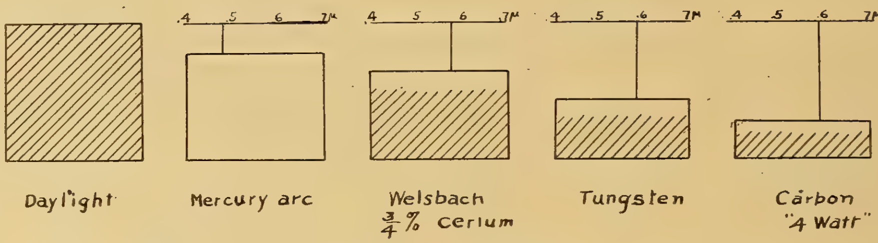
Before discussing the interpretation and utility of these quantities it is of interest to note several points in connection with the characteristics of white light and white sensation as here distinguished. If we write the above equation:

$$I_c - I^{\lambda} = I_w,$$

we express the condition for securing the largest possible amount of white sensation, namely, by subtracting light of one wave-length. The nearest approach to this practicable is to subtract a wide band in the neighborhood of λ. Inspection of the sensation curves shows that with a yellowish source, such as a glow lamp, absorption of a band near $.59\mu$ would, while reducing the red and green sensations, have slight effect on the blue, while the uniform absorption of method I. wastes considerable of that already deficient sensation. It would, therefore, be possible, by selective screening, to secure nearly the whole of the white sensation existing in the source. Since the white sensation value is the only white light value possessed by selective sources, and since the white sensation value may be

[5] Philosophical Transactions, *loc. cit.*
[6] The process of finding the dominant hue is much simplified by the use of Maxwell's color triangle.
[7] *Loc. cit.*

Fig. 4



Rectangles = Intensity of White Light Sensation

Shaded Portions = Intensity of Non-Selective White Light Available by Screening from .42μ

Spectral Hue of Lights Shown by Vertical Lines and Scales.

nearly obtained by selective screening of continuous spectrum light-sources, we might use the term "selective white" to designate it, although "white sensation" is preferred by the writer. It is of interest to note that with the sources considered, acetylene, etc., if the equality point for screening is taken as about .455 μ, the resultant (slightly yellowish) white is of very nearly the white sensation value. For some practical purposes, therefore, the white sensation values might be assumed to be the available white, in the case of continuous sources.

It is possible to apply the first method to the color sensation curves, for the ordinates of the curves giving the sensation value for a source may be reduced from the same equality point in the proportions demanded by the curves of Fig. 1, their area measured before and after reduction, and the luminosity values of the sensation applied as above. This was done as a check on the sensibility curve values, and the results agreed within the errors of measurement.

In table III. are given the sensation values of the various sources, their dominant hues, white sensation and white light efficiencies. The sensation values are so reduced that their sum equals 100 in each case. Column 4 (percentage white sensation) then expresses a purely hue or color efficiency, namely

$$\frac{\text{White sensation}}{\text{Total sensation,}}$$

where the sensations are assumed of equal value in white light. This ratio, not having a close connection with the problem of screening, or the possible experimental procedure outlined under method II., has not been considered at length.

In table IV. are given the values of "white light" and "white sensation" watts per candle for the electric glow lamps.

Discussion of Results.

Two methods have been developed for obtaining a measure of the approach of a light in color to daylight. Two values have been obtained for the quantity expressing the color efficiency. Their characteristics and interpretation are as follows:

First. The White Light Efficiency.—Obtained by consideration of the white light available by the use of absorbing screens. The white light obtained is non-selective white light, spectrally identical with Nichols' "average daylight." The term "white light efficiency" is applied to the ratio

$$\frac{\text{Intensity of Non-selective White Light Available}}{\text{Intensity of Source.}}$$

Its numerical value is dependent on the

point of the spectrum at which absorption starts and is zero for a bright line source. It is of practical importance as an indication of the loss in efficiency to be expected by producing "daylight" by the use of colored globes on artificial sources. As the white light obtained is identical with daylight the "white light efficiency" is a good indication of a source's excellence for use where color discrimination is necessary. The larger the proportion of available white light the nearer will colors appear in their daylight values.

Second. The White Sensation Efficiency.—Obtained by consideration of the amount of white which, with a spectrum color, would match the light. The term is applied to the ratio

$$\frac{\text{Intensity of White Sensation}}{\text{Intensity of Source.}}$$

The method is independent of any arbitrary screening point and is applicable to all types of sources. The white sensation obtained indicates the color of the light or of a white surface illuminated by it. It gives no indication of the suitability of a source for color discrimination. The white sensation is larger than the white light given by method I, and is as a rule only partly or not at all available as non-selective white light.

The question arises: Which of these efficiencies is it preferable to use? From a purely scientific standpoint the white sensation efficiency is preferable because of its universal application and independence of arbitrary screening point. The white light efficiency, however, furnishes information of importance in the consideration of artificial illuminants, namely, on the merits of a source for the purpose of illuminating colored objects. A method to include both values would be superior to either alone and an attempt to do this graphically is given in Fig. 4, in which the results of table III. are embodied. The rectangles indicate the white sensation efficiencies of the several sources, the shaded portions of the rectangles the white light efficiencies. The vertical lines and scales give the dominant hue. Inspection of the figures will show that they demonstrate in a rather striking manner the relative qualities of the sources from the standpoint of their color. A light of the type of II., for instance, is one of bluish hue, of about 80 per cent. white sensation, but a source not suited for color discrimination; a light of the type of III. is one of yellowish hue, with a large amount of available white, and therefore suited to color discrimination. In daylight the white sensation and white light areas are identical.

It is not claimed that this use of the white light efficiency in combination with the white sensation efficiency will lead to rigidly correct or strictly comparable results in all cases conceivable. For instance, a source consisting of a large number of bright lines evenly distributed through the spectrum would have zero white light efficiency, although it would be a pretty good light for color discrimination. This difficulty could, of course, be divided by agreement on the number and closeness of lines which may be considered equivalent to a continuous spectrum for purposes of illumination. On the other hand a source containing a large amount of available white may have such a spectral distribution as to be of less pleasant effect to the eye than one of smaller white light efficiency. This is, of course, rather a question of æsthetics or physiology than of physics. If we confine ourselves to the illuminants at present in use this combination of the two efficiencies presents the color characteristics of interest to the illuminating engineer more accurately than any classification known to the writer, and is, therefore, thought worth presenting.

The values obtained in this paper are dependent on the correctness of several sets of data—on the measurements of daylight by E. L. Nichols; on the measurements of artificial sources by the writer; on the sensibility curve of the eye as given by Abney; on the color sensation curves of Koenig-Exner; on the luminosity values of the sensations as given by Abney. Future measurements or redeterminations may change the numerical values. The principles involved, however, remain the same, and the methods developed give, it is believed, a new and useful basis for the color comparison of artificial illuminants.

The Ins and Outs of Illuminating Engineering

There is a well known fable of a fox who was sure that the grapes which he could not reach were sour, and another of a dog lying in a manger and refusing to allow any other animal to eat the hay which he could not eat himself. If we could in some way form a cross between these two fables we might obtain a moral that would apply to a certain element in the lighting field. This element consists of those who accuse illuminating engineering in general, and the Illuminating Engineering Society in particular, of being only a scheme for promoting private interests, and yet who refuse to participate, even though repeatedly and urgently invited to do so. This element is in precisely the anomalous position of those citizens who rail at the government for being corrupt, and then persistently stay away from the primaries and the polls. If the Illuminating Engineering Society and the profession in general is dominated by any particular interest or combination of interests then the only way to put an end to such domination is for a sufficient number of other interests to enter actively into the work to prevent it. There is not the slightest occasion for sympathy for a majority that allows itself to be ruled by the minority, and then stays on the outside and snarls. If those who are out are dissatisfied with the conduct of those who are in, let the outs get in and show their faith by their works.

The Illuminating Engineering Society is an absolutely open forum, and not only welcomes papers and discussion on every possible phase of the subect, but is most anxious to obtain them; for it is by these that the society lives. Every man having an idea to express "touchin' on and appertainin' to" the subject of lighting will find a ready audience at any meeting of the society, but he must not object if he finds that all do not agree with his views. Science aims at the truth, and this can only be approached through unbiased discussion.

What is true of the society is also true of this publication. It is open to the absolutely uncensored expression of fact or opinion, provided only that such expressions are made in good faith, as evidenced by a personal signature.

Envy has been well described as "the vice of small minds," and any one who admits, directly or by inference, his envy of others who are actually, or in his own imagination, outstripping him in the race for success only convicts himself of this vice. Don't stand on the outside and sniff or growl; get on the inside and show your strength.

As They Do It in England

Science and its application belongs to no particular country, and has its own universal language. The details of applied science naturally vary, exhibiting peculiarities due to national and personal characteristics, just as a common language will break up into dialects and patois. An electric lamp may have different shapes of bulb, but it must have a switch in all countries, and its light will enable the user to read one language as well as another.

This subject of the universality of science is an enticing one to the philosophical or ruminating mind; but its further pursuit at this point would lead us too far afield. The point we are coming at is this: the study of illuminating methods practised in different countries is interesting from both the scientific and human interest sides of the subject: a German works and plays after the manner of his race, and John Bull gives an English impress to whatever he touches. It is a universal instinct to assume that our ways are the only right ways. Foreigners are still "barbarians,' as they were to the ancient Greeks. It requires a considerable amount of mental effort to admit that barbarians may do something better than we do it, and a still higher degree of moral courage to abandon our own ways and take up those of the outlanders.

Unprejudiced observation, however, will convince the most patriotic and self-confident of us that there are many things which the foreigner does better than we Americans. It is the part of wisdom to follow the advice laid down long ago to "prove all things, and hold fast that which is good," particularly noting that "all things are not comprehended in our own time and country. We have previously noted that the recent revolutionary improvements in the means of producing light have without exception borne the familiar imprint, "Made in Germany"; and we are forced to admit that we have not only been followers, but tardy followers at that.

In order that our readers may have a general survey of the prevailing practices and projected improvements in Europe, we have secured regular correspondents in England and Germany, and shall present, from time to time, special articles by other authorities on the subjects treated. We would call attention to the interesting correspondence in the September issue from Mr. James A. Seager.

It was not very long ago that it was the fashion to declaim against the industrial invasion from England, and to predict our early financial subjugation by this insidious campaign; and for no better reason than that English capitalists had bought a few breweries and flour mills; and still the patriotic American today need suffer neither hunger nor thirst for lack of American bread or beer.

The same cry now comes back from England like an echo; and the "American Invasion" is a reality to the Briton. One of the most conspicuous instances of this invasion is an American department store recently opened in London by Mr. Selfridge, of Marshall Field, Chicago, fame. The photographs of the interior, showing the method of illumination will, therefore, be especially interesting. It will also tickle the vanity of the Americans to note that the arc lamps were made by the British Westinghouse Company, a corporate title indicating a happy union of American inventive genius with British capital.

There is a detail in the illustration of the electric show room located in the "White City"—where have we heard that name before?—which will repay a more careful examination. We refer to the two-light electric fixture suspended from the ceiling. This is, practically, a drop cord arrangement; but observe what a difference in appearance between this simple device and the hopelessly plain, if not ugly, drop light used in this country. The spreader and handle for raising and lowering the lamps is simplicity reduced to its lowest terms; and yet the curves, together with the parallel lines of the supporting cord, have a distinctly artistic effect, which is greatly enhanced by the decorative shades over the lamps. This surely is a realization of the fixture in which the structure is proportional to the weight of the lighting units. Observe, furthermore, that by the use of a counter-balancing weight (not shown in the cut), the lamp can be raised and lowered through a considerable distance. We do not maintain that such a device would always be a suitable substitute for the more substantial and decorative American fixture. It does show, however, in an impressive manner, how easy it is to produce an artistic effect with the same materials that ordinarily would be indifferent or ugly. A very much larger use is made of flexible cord in the construction of electric lighting fixtures in Europe than in this country, a fact which may profitably engage our attention.

Details in Engineering

To the lay mind all scientific work, whether applied or theoretical, appears to be made up largely of a mass of details which are more or less trifling in their nature. Read any technical paper describing an original investigation, and if the investigation has been carefully made and the report well written, you will find in the record a great number of facts which in themselves are commonplace and apparently without particular value. To the experienced investigator, however, this elaboration of detail is an exact meas- which it records, and of the value of the report to other investigators. Exactness is the very essence of science; Exactness is the very essence of science; and the distinguishing characteristic of the scientifically trained mind is the ability to see and record phenomena that would entirely escape ordinary observation.

An English technical journal some months ago refused to consider illuminating engineering in a serious manner, for the reason that it could see nothing in it beyond what Henry James has termed "the elaboration of the obvious." Doubtless many others who have gone no farther than to read the technical description of some particular lighting installation, or a technical paper reporting an investigation, have shared the same opinion. Of course, it cannot be denied that detail may be spun out to an unnecessary length; but it is vastly safer to err in this direction in scientific work than in the opposite direction, and no one who is not perfectly familiar with the subject treated is at all competent to judge as to the value of detail.

Again, details which may be absolutely essential in the first stages of development of a particular branch of science may become so well known as to be safely omitted at a later stage of its development. Such instances will readily occur to those who are thoroughly familiar with scientific development, either through study or practice.

One other interesting observation bearing upon the subject: All of the great generalizations in science, or, according to the common expression, the discovery of the great scientific laws—like that of gravitation, for example—have been the result of years and often centuries of accumulation of details, which in themselves seem to be as valueless as a record of the sizes and shapes of holes in different pieces of Swiss cheese.

Illuminating engineering is a branch of applied science which has newly separated itself from the parent stem. In its present state, therefore, all of the conditions are present which necessitate attention to details. No measurement, observation or opinion that can possibly arise, either in the theory or application of the science, is, therefore, unworthy of record. Let no practising illuminating engineer feel the slightest hesitation in recording what might seem to the layman the most trivial fact of circumstance. It is only by a long series of such study and record of minutia that the science can be developed to the full possibilities which it possesses.

The New Secretary of the National Electric Light Association

The announcement made in the *Electrical World* of September 16th that Mr. T. Commerford Martin has resigned his position as co-editor of that journal to become the general secretary of the National Electric Light Association will occasion some surprise among the host of readers who are familiar with his work as an editor, and as a special contributor to the United States Census Bureau. As an editor, first of the *Electrical Engineer* and later of the *Electrical World*, Mr. Martin has always stood for progress, independence and ethical principles of technical journalism; and the world-wide recognition of the journal with which his name has so long been connected is a tribute to his personality and vigorous and effective work. Editorial personality has become almost extinct in connection with the newspaper press and the literary periodical, and there is a painful lack of this vitalizing force in the class journals of the present day. The loss of an editor of Mr. Martin's caliber to any publication with which he might be connected would be severe.

The fact that Mr. Martin gives up a

work with which he has so long been intimately connected, and which has such wide possibilities for influence, to take the active management of a commercial organization is an event which possesses more than personal interest. It shows the position of power and influence which this organization has reached. As one of its original promoters, Mr. Martin will feel an almost fatherly interest in guiding its destinies from this time on. It is clearly a case of the office seeking the man and being honored by his acceptance. The natural growth of this association, stimulated by the application of those qualities which have invariably made for success in technical journalism at the hands of its new secretary, the limits of its power for good in promoting a better and wider use of electric light will be greatly enlarged.

We congratulate the National Electric Light Association upon securing Mr. Martin as its active head.

Illuminating Engineering Courses in the Colleges

As the season for the opening of colleges and technical schools is at hand the question of the facilities offered for the study of illuminating engineering naturally suggests itself. While a specialized course ending in a formal degree Illuminating Engineer is still some distance in the future, the direct attention that has been given to the subject by the colleges, either in the way of specializing certain courses pertaining to the science or in introducing new courses, is most gratifying to those who are interested in the progress of the profession.

The most complete course offered in the subject is that given at the Armour Institute of Technology, Chicago. This institution was also the first to give extended attention to the subject, having established a course in the fall of 1907. A description of the work done, and the general layout of the course, will be found in a paper read by Mr. W. E. Barrows, Jr., before the Chicago Section of the Illuminating Engineering Society, and reported in the May, 1909, transactions.

Apparently the first institution of all to foresee illuminating engineering as a distinct branch of science was the University of Wisconsin, which gave instruction along these lines as far back as 1896.

Cornell University has been especially prominent in its research work in the general subject of lighting. It has adopted courses for the special benefit of those contemplating the illuminating engineering profession, an outline of which is given in Mr. Richtmeyer's paper before the present convention.

The facilities offered at the Massachusetts Institute of Technology were given by Professor Shaad in one of our previous issues.

A single lecture on the subject of illuminating engineering as a profession was given to the seniors of Swarthmore College last winter, which aroused such interest that a special course on illumination will be given during the coming year.

These are important cases which have come to our immediate notice. There are doubtless many other institutions in which similar work is being done.

Chocolate Coating the Tablet

There is a lot in a name, Juliet's opinion to the contrary notwithstanding. A rose by some other name will not only smell as sweet, but may lose a lot of its thorns, and become acceptable in cases where, under its own cognomen, it would produce instant symptoms of rose cold and lacerated fingers. There is philosophy as well as science in the use of names. This is brought out in a delicious manner in Ouida's fable of "Meleagris Gallapavo." These tongue twisting words are the scientific name for the common turkey; and Ouida tells, with her usual scintillating wit and hissing, acidulous sarcasm, how a specimen of this useful domestic fowl, on being told its family name, became so possessed with its own importance in the world and suffered such a swelling of the head in consequence that the speedy amputation of that member was performed by the local butcher.

But lest we wander too far from our moral, let us state it without more ado. Illuminating engineer is an expression having a fairly exact meaning; and the words, individually and collectively, seem to be innocent enough to the ordinary reader. And yet it appears that the ex-

pression must be used with some caution lest offence be given. The word engineer alone, it seems, is not without a sinister sound to certain professional ears that have been attuned in the Ecole des Beaux Arts to receive no harsher tones than the "music of the spheres"; and when to this is added the word illuminating, the discord becomes intolerable. The fact that the efforts of the individual bearing this inharmonious title is undoubtedly beneficient, involving nothing else than an endeavor to make better use of the two most priceless boons given to man—light and vision—indeed lifts him above utter contempt: if only this really useful result could be secured without encountering the malodorous title!

There are many who believe that the end justifies the means, and who are, therefore, for the sake of the good to be accomplished, willing to be known as common turkey instead of melleagris gallapavo—in other words, to do illuminating engineering without assuming or mentioning the title of the profession. This is well. Good works, as well as murder, will out. It matters little what it is called so long as lighting is put in with an intelligent consideration of all the factors in the problem; which constitutes illuminating engineering.

If you have a natural antipathy to employing a doctor you may, in an emergency, be willing to accept the services of a health adviser; and the fact that the rhubarb and ipecac which he gives you are chocolate coated does not in the least interfere with their proper action.

From all that we can learn the course of true science never did run smooth, and why should the illuminating engineer consider himself favored above others?

Let him, therefore, continue his good work, even though for the time being he must suppress the offending title of his profession.

Notes and Comments

Better Lighting of Railway Cars Being Agitated

RAILWAY MEN GIVING MORE ATTENTION TO THE DEMANDS OF THE PUBLIC IN THIS RESPECT.

If there is anything in America which has been carried out with absolute disregard of expense it is the construction and furnishing of the Pullman car; but with all its luxury and magnificence the illumination has been abominable. The Pullman car furnishes a most glaring example of the difference between light and illumination. The quantity of light is ample, but instead of its being thrown down where needed for reading and other use, it is allowed to waste itself in the upper part of the car, leaving the bare, dazzling light sources shining directly into the eyes. The substitution of electric lamps for gas flames has in many cases increased the fault rather than improved the lighting. There is now an Association of Car Lighting Engineers; and it is to be hoped that this body will give as much study to the illuminating engineering side of the problem, which has been most sadly neglected, as to the mechanical details. It is not more light, but better illumination that is wanted.

As showing the popular interest in the subject the following items recently appeared in the daily press:

> Better car lighting is a question that still puzzles railroad folks. The causes that contribute to the poor lighting of to-day is the dark finish of the cars and the infrequent placing of the lights.
>
> It is suggested by lighting engineers that there should be less economy in the use of individual lights and that the finish of the cars should be light and of such a nature as would deflect light instead of absorbing it, as a dark finish often will do.
>
> Experts who have made these criticisms say that the remedy lies in the builders employing an illuminating engineer.

More Lights Glimmer in Buffalo

THE NEAR-ELECTRIC CITY CONTINUES TO SHOW UNMISTAKABLE SIGNS OF AWAKENING IN MATTERS OF PUBLIC LIGHTING.

The legal attempt made to stop work on the new lighting plant in its County

Building was sat down upon by the court; with the sale of the old gas fixtures, for which some collector bid the astonishing sum of $500, the completion of the electric plant and the installment of the especially designed chandeliers, the contract for which fell to the lot of a New York manufacturer who is distinguished for taking an active interest in illuminating engineering, this episode will be successfully closed.

The citizens are evidently beginning to realize the value of adequate public lighting and are recovering from the spasm of parsimony that seems to have come in with the reform administration. As a straw showing the trend of the wind, the *Times* says:

The lights on the wall at Gates Circle will soon be glowing again, after two years of darkness. A contract has been let to wire the old gas fixtures for electricity, and this work is now under construction.

The lighting of Convention Hall is also receiving attention, according to the *News:*

"The hall has been cleaned throughout and repainted and fixed up generally," said the commissioner. "Some additional windows have been made, to increase the lighting facilities in the daytime, and a rearrangement of the electric lighting system has also been made.

"Hereafter, instead of rattling old arc lamps that lighted the hall imperfectly and often annoyed audiences, we will have a new system with tungsten incandescent lamps that give more light and no noise."

Lastly, the city is to have a commercial exposition lasting for ten days, from October 6th to 16th, and the plans involve a large use of spectacular electric lighting, the chief feature of which will be an appropriate arch at the gateway.

Philadelphia at Last Settles Upon a Plan for Lighting Market Street

DECIDES UPON THE USE OF SIDEWALK STANDARDS.

The tangle over the method of lighting Market street seems to have at last been straightened out by the adoption of the City Electrician's plan of erecting handsome standards along the curb in place of the posts in the center of the street, as originally contemplated, and the arches which were suggested as a substitute when the central posts were found impracticable.

City Electrician McLaughlin is thus quoted by the *Press*:

"With these arches," he said, "Market street would have the appearance of an elevated railroad structure from Juniper street to the Delaware River.

"I have worked out a plan which I think will accomplish the desired end. I propose to erect a number of ornamental lamp standards on the curb line, with two lights of 2000 cp. each on each standard, and two at each corner of the intersection, which would make 16,000 cp. at each intersection. To accomplish this result it will require 181 additional lamps, with 31 that are there now, making a total of 212 lamps."

The specification of "2000 candle power lamps" is interesting in view of the fact that this can now be literally fulfilled, instead of only nominally as in the old lighting contracts, the flaming arc being quite able to meet the condition. Mr. McLaughlin's plan is undoubtedly the best solution of the problem.

Lo, the Poor Indian, Now Walks His Own White Way!

CHEROKEE HAS A SPECTACULAR STREET LIGHTING INSTALLATION.

Pope's famous lines should now be amended to read as follows:

Lo, the poor Indian, whose untutored mind
Sees God in clouds, or hears Him in the wind;
His steps proud Science never taught to stray
As far as solar walk or Great White Way.

The Guthrie *Capital* has the following description in a special from Cherokee, Okla.:

This city now has the only "Great White Way" in the State of Oklahoma. It was put in operation last Saturday night by Engineer Eckes, and travelers and others who were in the city stated that it was ahead of any municipal improvement in the State, regardless of size. The White Way runs the entire length of the business blocks of the city. It is a system operated by a municipal plant, using alternating current. The lights are 40 cp. tungstens placed on concrete poles 12 ft. high. The poles are molded after the ones on Pennsylvania avenue in Washington, and are placed on a foundation at the edge of the curbing. Sixteen-ft. sidewalks have been built all over

the business section, and they form the partial base for the White Way posts. The posts are arranged eight to the block on each side of the street, except in the immediate business center of the city, where the number is doubled. There are also six arc lights with 10,000 cp. illumination which are placed on the principal buildings. The lighting system starts at the new municipal park where the lights are arranged in circular clusters and extends from the Orient Station to the Santa Fé.

Another Carnival of Light

Seneca Falls to Have a Gorgeously Lighted Merchants' Exposition.

The possibilities of spectacular lighting as an attraction for fairs and carnivals is making itself manifest in the increasing number of such festivities that are being held. These are by no means confined to the larger cities, but are common to the smaller towns as well. Seneca Falls is one of the oldest and most prosperous villages in the State, and the following special to the Rochester *Democrat and Chronicle* contains some valuable hints to central stations and enterprising merchants in other towns and villages:

The electrical display at the merchants' fair next week will be one of the most beautiful ever seen in this village. The Lighting Committee of the carnival will furnish 1500 incandescent lights in festoons and a piece of 300 lights. The piece represents a waving flag. The various merchants along the streets where the fair is to be held are to decorate their buildings with bunting and lights. These additional lights will make the streets of the village as bright as day for the week.

Citizens of Springfield, Ohio, Take a Hand in the Street Lighting Controversy

Object to Having Welsbach Lamps Removed.

The *News*, under the general caption, "Shall the Welsbach Lamps Be Removed from Our Streets?" prints ten different petitions, with the names of the signers, that have been presented to the City Council in favor of retaining the present street lighting system, and gives the following paragraph in explanation—you can make your own comments:

The Electric Light people have failed for years in their efforts to displace the Welsbach street lamps by tests of the merits of the two lighting systems. The people who live on Welsbach lighted streets have on five different occasions defeated the attempts made before Council in this city to place arc lights on streets where Welsbach lamps were in use.

News from the Front

The Seventh Street Improvement Association, Portland, Ore., has won its whirlwind campaign for the spectacular lighting of the particular section of Seventh street in which it is interested. The plan contemplates standards bearing clusters of five lamps, placed fifty feet apart on each side of the street. The entire expense will be met by the property owners.

The La Loma Improvement Club has been organized in Berkeley, Cal., for the purpose of securing better lighting facilities for a particular section of the town.

The City Council, Billings, Mont., has turned down the proposition to install a modern lighting system in the business portion of the city. The citizens immediately took the matter in hand, and are rapidly obtaining private subscriptions to carry the plan into operation.

The city of Monrovia, Cal., has a committee working on an improved street lighting system for its business section. The city is now lighted with 16 candle power lamps, which are lightly considered inadequate for the business streets. It is proposed to use standards similar to those in Los Angeles.

Merchants in Stockton, Cal., are subscribing to a fund for illuminating the principal section of Main street with arc lamps.

Citizens of Berkeley, Cal., are again agitating the subject of better street lighting for the center of the city, particularly along the thoroughfare leading to the entrance to the University Campus.

The Newhouse Realty Company, of Salt Lake City, has applied to the Council for permission to install its own system of electric street illumination in the vicinity of its own building. It proposes to use arc lights on goose-neck poles forty-two feet apart.

Correspondence

Electric Illumination Topics in Great Britain

By James A. Seager.

(*Special Correspondent.*)

At the beginning of 1906 a complete system of medical inspection was provided for all the London public schools. One of the most important sections of the work is the detailed examination of many children, including vision testing, and the inquiry into school conditions, such as lighting, heating, ventilation, etc. The vision of all the children is preliminarily tested by the teachers once in twelve months, one-half of the school in April and the other in September, and the names of all children whose vision is found defective below a certain standard are placed on forms provided. When the doctor visits the school he tests the vision of the children returned as defective, and advises as to the amount of defect found, giving cards upon the hospital authorities for treatment. In addition the doctor goes over the school with regard to window and artificial lighting.

The results of vision tests over two periods, the first from the first of April, 1907, to the thirty-first of March, 1908, and the second from the first of April to the thirty-first of December, 1908, may be compared. Contrasting the two periods, we have:

	First period.	Second period.
Total number of scholars on registers	473,145	313,415
Returned as defective by teachers	10.75%	9.36%
Returned as defective by oculists	7.43%	6.58%
Ordinary advice given	4.48%	4.25%
Urgent advice given	1.75%	1.27%

Though it is unsafe to argue broadly over such a short lapse of time, it is interesting to note the following report upon the general conditions of the school rooms as regards lighting, over the same two periods:

Lighting of—		First period.	Second period.
Non-provided schools	Good.	57	18
	Fair.	10	3
	Bad.	21	4
Council schools	Good.	191	237
	Fair.	16	23
	Bad.	52	33

It is at least curious that a slight improvement of the physical condition of

FIG. 1.—GAS LANTERN RECONSTRUCTED FOR TUNGSTEN LAMPS.

FIG. 2.—RECONSTRUCTED TUNGSTEN FIXTURE IN CANTERBURY.

the children with regard to vision is coincident with a similar improvement with regard to the lighting of the schools.

What the ideas of the London County Council educational authorities are upon the question of efficient artificial lighting may best be gleaned from the previous report, in which the results of the inquiry undertaken by Mr. Bishop Harding on the question of illumination of class rooms are given. It is impossible to go into this in detail, but one or two electrical data may be quoted. Two kinds of opal shades are in use in the schools; one subtends 110 degrees in the sides and is 3⅛ in. deep vertically. This does not cover the lamp and exposes the incandescent filament to the teachers' eyes. The other shade has sides subtending an angle of 80 degrees, with a vertical depth of 5 in. This screens the light from the teacher and increases the light below by one-third, as shown by the attached table of meter-candles taken from a 16 candle power lamp in a plane 4 ft. below the lamp level with a Wingen's photometer:

Shade.	Vertically below lamps.	1 yd. to side.	2 yds.	3 yds.	4 yds.
None	5 m. c.	+3	+1	1	1
110° shade....	20	9	5	3	1
80° shade....	30	9	5	2	1

It was suggested, in order to diminish the image of the filament thrown, that the bulbs should be as large as possible and the filament twisted in as long a loop as possible. Tantalum lamps were recommended. The tungsten filaments were apparently not then in a position to be tested.

As regards the distribution of light in the class rooms it was recommended that, beginning at the left hand of the children's portion of the class room, a lamp should be hung over the center of the first dual desk and from there across the breadth of the room, at distances of 6 ft. for 16 candle power lamps. A second similar row should be placed over the third row of desks. The idea of hanging lamps over a back row of desks for the purpose of illuminating desks in front

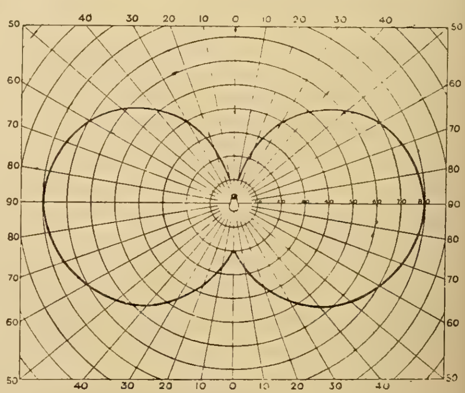
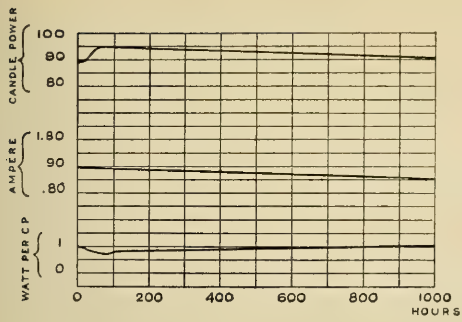


FIG. 3.—PHOTOMETRIC CURVE OF NEW "METALITE" LAMP.



Life Curve.

FIG. 4.

was pointed out as unsatisfactory when the children are in their seats. A lamp used specially to illuminate the desk and blackboard should be completely shaded from the children's portion of the room, and the use of electric light should be restricted to the class rooms, naked gas jets with wire frames being used in the staircases and passages.

A very useful brochure on street lighting by electricity has just been published by Mr. Haydn T. Harrison, M. I. E. E., of Westminster. The Harrison Universal photometer is well known, and its inventor has attained considerable renown by his researches on street lighting. He is now turning to account his specialized knowledge by the manufacture of street lighting fittings, and with the advent of the tungsten lamps street lighting by electricity is becoming competitive with gas. Fig. 1 shows one type of these fittings applied to existing gas lanterns in the Marylebone area of London. Another type of fitting, for use without globes and applied to the system in the historic town of Canterbury, is shown in Fig. 2. In this case the fuse is fixed in the base and the fitting supplied with a spigot cap only for slipping over the top of the existing gas lamppost. Some very interesting figures are given from the result of his testing experience, which are worth recording. From a large number of measurements made all over Great Britain it was found that the minimum illumination for main thoroughfares averaged .05 candle-feet, side streets .025 candle-feet, suburban roads .005 candle-feet. With existing gas mantles giving an average of 50 candle power, with two mantles in main street lanterns and one in the other, this is equal to posts at an appropriate distance in main thoroughfares of 30 to 40 yards; in side streets, 30 to 40 yards, and in suburban roads, 50 to 80 yards. As it is the custom of most makers of lamps to state the maximum candle-power of their lamps, whereas for street lighting purposes it is necessary to know the candle-power of the horizontal and, say, 20 degrees below, Mr. Harrison gives an approximate table of the ratio of these rays to the maximum, when ordinary standard globes without special prisms or reflectors to divert the rays. Flame lamps of the Blondel or regenerative types are not included:

Type of lamp.	Ratio of rays 10° below horizontal to maximum.	C. P. of rays (10°) per watt.
Tungsten	1	.8
Tantalum	1	.6
Enclosed arc (D. C.)	.35	.5 to .4
Enclosed arc (A. C.)	.5	.4 to .3
Open type arc	.4	.9
Ordinary flame arc	.3	1

Reference may be made to the progress of a British made tungsten lamp called the "Metalite," manufactured by the Bryant Trading Syndicate, Ltd., of London, according to the process developed by Mr. F. Harrison. The illumination curve shown in Fig. 3 shows the light given at different angles, while from the life curve given in Fig. 4 it will be seen that the watts per candle power slightly increase as the lamp passes to the latter end of its life. It is rather interesting to note that an enormous economy is obtained if the lamps are under run, as shown by Fig. 5, which shows the relation between the candle power and the watts per candle to the voltage of supply, and at the present time filaments constructed under the Harrison process are being supplied to a large number of British, Continental and American lamp makers.

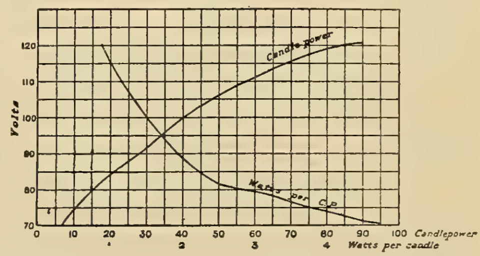


FIG. 5.

Commercial Engineering of Illumination

The Sale of Fixtures by Lighting Companies

There is a natural and proper hesitancy on the part of commercial organizations handling a special line to branch out into subsidiary lines. It is perfectly safe to say that no supply company, whether of gas or electricity, desires to take up the manufacture, or even the sale of lighting fixtures, for the sake of what profits may accrue from the business itself. If, therefore, they take it up at all it will be in self-defence.

This, however, applies more particularly to the general class of lighting fixtures which are more or less elaborate in design and require special skill and facilities for their installation. The simplicity of the electric light makes the use of the traditional chandelier type of lighting fixture unnecessary in a great many cases and has developed a new type of fixture which may be distinguished as the "lighting unit." These units are strictly utilitarian, the decorative features being purely incidental, and their construction such that they can be readily put in place with no other skill or tools than those possessed by the average wireman. Such units are naturally inexpensive to manufacture, since the two elements which make up the bulk of the cost in the special fixture or chandelier are wholly wanting, namely, limited number, and artistic skill in design and execution. The lighting unit is a mechanical device which has for its sole purpose the most efficient illuminating results, and which, when once perfected, can be turned out in large quantities like any other piece of simple mechanism. That this type of fixture should be sold by lighting companies is quite as natural and legitimate as that they should sell arc lamps. The line of Nernst lamp units furnishes an example of this kind of fixture. The introduction of the tungsten lamp, which has some material differences from the carbon lamp, has also given rise to various lighting units of this order.

Those engaged in the manufacture and sale of luminants not only have the right, but are in duty bound, to promote the sale of their product in every legitimate way; and to see that their consumers are able to purchase suitable devices with which to use their luminants is certainly legitimate. If they find that such devices are not readily obtainable from those engaged in that particular line of business, then they are quite justified in supplying the deficiency, either by inducing the manufacturers themselves to produce goods that are suitable in design and reasonable in price, but failing this, even to take up the manufacture and sale on their own account.

Modern lighting conditions must inevitably bring about a change in the "fixture business" along the lines indicated. The division of fixtures into what are special and artistic, and what are common and commercial must become more and more sharply defined. No lighting company will ever care to meddle with the fixture installation, which is a part of the architectural and decorative features of the building; that belongs to the architect and the owner. On the other hand, they will not be content to sit by and see

their consumers obliged to use an antiquated fixture revamped to received modern light-sources, and sold at an exaggerated price.

The commercial fixture must be manufactured and sold on a commercial basis. If you have your portrait painted you expect to pay the artist according to his worth; but when you sit to the photographer you expect to pay only the regular price for the products of his handicraft. The value and demand for the work of the artist is by no means lessened by the work of the craftsman and mechanic. The business of making and selling lighting fixtures will not suffer in any way by the division which is being more and more clearly defined; on the contrary, conditions will improve. What is truly artistic will not be less appreciated by being separated from what is purely mechanical; rather will it receive greater attention and appreciation.

Notwithstanding the large and increasing use of the lighting unit or commercial fixture, there is a decided improvement observable in the artistic merits of installations of the higher order. Whether the manufacturer of fixtures will select the one or the other of these divisions exclusively remains to be seen, and is of little practical moment. That lighting companies will more and more engage in the sale of lighting units is beyond question. Such a course is in the natural line of progress, and whatever temporary inconveniences may be felt during the process of readjustment, a betterment in conditions all around must inevitably result. A great improvement in commercial lighting fixtures, so far as artistic design is concerned, is already in evidence. The arc lamp when used for interior lighting may well be classed as a lighting fixture, and in its latest patterns is distinctly decorative. The tungsten lamp when newly installed is given a decorative setting, and the ugliness of the earlier forms of the incandescent gas burner have almost entirely disappeared. The wheels of progress may occasionally get a jolt and temporarily slacken their pace, but they never stop.

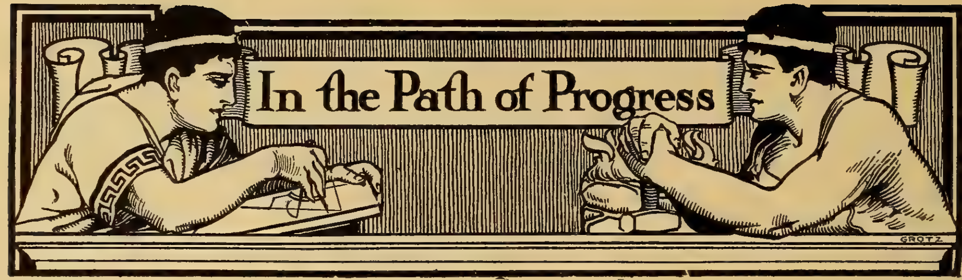
Quality, or Economy?

All "talking points" and selling arguments may be divided into two general classes: Quality and price. Every buyer is naturally seeking to combine these two to the greatest possible extent, but every buyer having average intelligence knows that there is a certain irreducible minimum beyond which such a combination is impossible. This holds with light and illumination as with all other commodities. The cheapest method of producing artificial light at the present time is with gasoline and a mantle burner. If cost were the only consideration therefore, this would be the leading light-source today, but it is not; in fact it is pretty nearly at the tail end of the procession, which is convincing proof that mere luminous efficiency is a second consideration in this country at the present time. This is corroborated by the fact that the incandescent electric lamp, which is the most expensive source, is one of the most popular.

It is a mistake for either the central station or the gas company to lay overmuch stress upon the cheapness of the latest forms of light-sources. Better illumination is the thing to talk, at least in nine cases out of ten; not merely because this seems to offer the greater income, but because it is the actual thing that is needed. The customer that is given what he needs, especially if he does not fully realize or appreciate his needs himself, will become the firmest adherent thereafter.

Economy at its best is merely the avoidance of waste. In this, its true sense, economy should be carefully observed. To use fixtures or accessories that simply waste light, or to put in a useless excess of illumination, is sinful extravagance; but to use any quantity of light for accomplishing a definite purpose, whether such purpose be utilitarian or æsthetic, is at base true economy.

Quality appeals to and expresses the higher and better elements in human nature. Cheapness alone is only a particular form of petty selfishness.



The Carbon Arc Lamp

The first thought that suggests itself when a new invention or a radical improvement is announced is that all previous articles of the same general nature must speedily become extinct. This is rarely the case. Improvements and inventions have added to our sum total of conveniences and facilities with but little subtraction of the old. This is particularly true in the field of lighting. There are more candles used to-day than ever before; the oil lamp still holds an exceedingly important place; gas flames are in use by the millions, and the very latest forms of arc and incandescent electric lamps will continue to exist side by side with the earlier forms, at least for some time to come.

The flaming and metallic arcs have peculiar advantages which give them undoubted superiority for certain purposes, but there is no one light-source yet that can claim the entire field. The carbon arc still possesses sufficient advantages to insure it a long lease of life, at least in competition with other sources at present developed.

It is interesting to note that improvements in this popular and valuable form of lamp still continue. A carbon lamp having very distinctive features, which has been given the name of "Intensified Arc" by its manufacturers, the General Electric Company, Schenectady, N. Y., is noteworthy among these improvements. The following description of this lamp has been furnished us by request:

The intensified enclosed arc lamp marks a distinct advance in the field of interior illumination, incorporating as it does all the advantages of the enclosed arc lamp, together with numerous improvements. For years the enclosed arc lamp has been greatly in favor for general mercantile lighting in virtue of the whiteness of its light, low maintenance cost and high efficiency. By a radical change of design the intensified arc lamp maintains these special points of superiority even over the other improved artificial illuminants.

A sectional view (Fig. 1) shows the construction of the new lamp. Two upper or positive carbons, six mm. in diameter and 305 mm. in length, are placed in converging tubes, so that the ends of the carbons are in contact. A self-act-

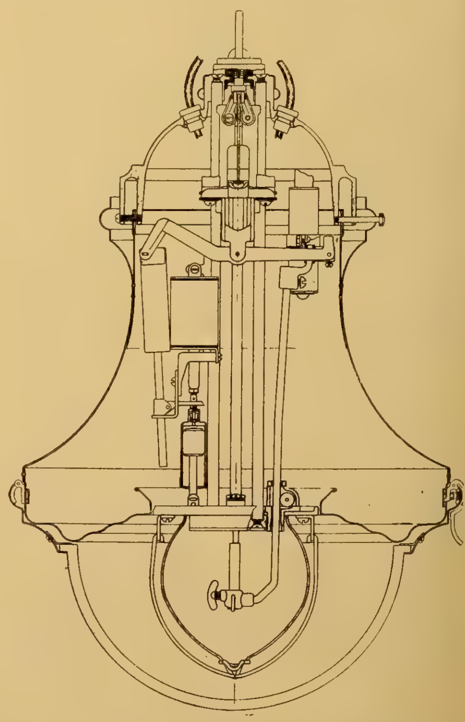


FIG. 1.—SECTION THROUGH INTENSIFIED ARC LAMP.

FIG. 2.—INTENSIFIED ARC LAMP, EMPIRE STYLE ORNAMENTATION.

ing weight bearing down on the top prevents one carbon from being consumed faster than the other.

One lower or negative carbon is used, 9½ mm. in diameter and 100 mm. in length. The lower carbon holder is movable in a vertical direction, being attached to a counter weight mechanism through which the action of gravity tends to hold it in contact with the upper carbons. The magnets, acting through a clutch on a rod of the counter weight mechanism, draws the lower carbon downward away from the upper ones. In this way the magnets cause the carbons to strike and maintain the arc, keeping the lower carbon floating at the point of electrical equilibrium.

When an arc is formed, the current density is much greater at the carbon tips than in the case of the standard enclosed lamp; and as the resultant heat cannot be readily dissipated, the carbon tips pass beyond the usual red-hot poker stage to the incandescent or white hot state.

In order to obtain the highest efficiency possible, a small diffuser is used, located directly above the arc. In this way a greater percentage of the light is distributed in the lower hemisphere. The resultant efficiency, therefore is equal to about 1¼ watts per mean lower hemispherical candle power at five amperes and 110 volts D. C.

The distribution of light, as shown in Fig. 3, is ideal for interior illumination, since maximum intensity is obtained on the working plane where most needed. Perhaps one of the most noticeable features of the lamp is the daylight effect created when in use. The light is of a soft, almost perfect white tone, and is steadily and evenly distributed. So pleasant and restful is the lighting produced one is hardly conscious of the illumination.

At five amperes and 110 volts D. C. a carbon life of 75 to 100 hours is obtained. This long life, together with the high efficiency, reduces the maintenance cost to a minimum, so that with the intensified arc lamp it is now possible to obtain the very best grade of illumination in large interiors at a minimum cost. The lamp can be furnished for either D. C. or A. C. multiple circuits.

Fig. 2 represents the intensified arc lamp equipped with ornamental casing. It will be noticed that this lamp differs materially from conventional designs and has very pleasing lines. The outer globe is made of leaded glass to correspond in effect with the casing. The lamp will, appeal to drygoods, clothing and department stores, as it fills a long felt want for an illuminant which is attractive by day as well as by night, and at the same time which meets the requirements of high grade illumination and minimum cost.

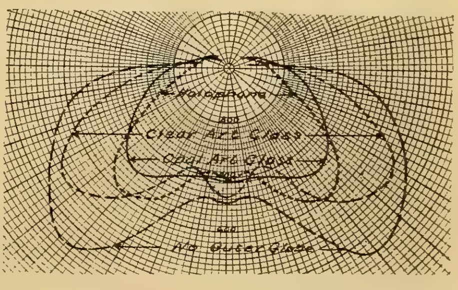


FIG. 3.—PHOTOMETRIC CURVES CHARACTERISTIC OF INTENSIFIED ARC LAMPS WITH OPAL ART GLASS OUTER GLOBE.

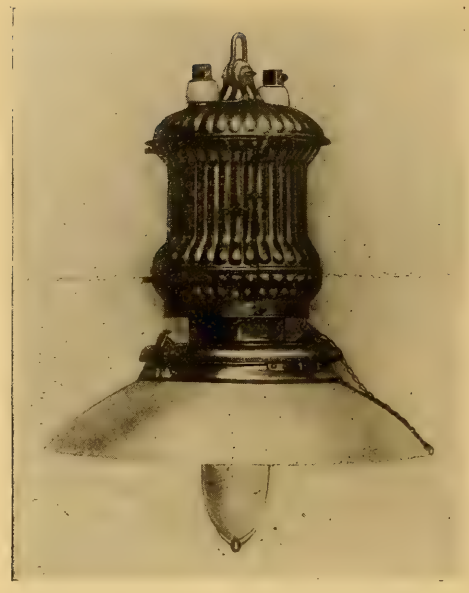


FIG. 1.—NEW WESTINGHOUSE ENCLOSED SERIES MULTIPLE D. C. ARC LAMP.

Improvements in lamps, adapting them to the various conditions of current supply, as well as illuminating results, are equally noteworthy. In this field the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., has come forward with a new series-multiple, direct current arc, of which the following description will be of special interest to those desiring to keep posted in arc lamp progress:

Series-multiple arc lamps have proved a very convenient and satisfactory means of illumination for places where only constant-potential circuits are available. They are adapted for connection in series-groups across 220 and 500 volt circuits, and this use makes it possible to operate arc lights, with their many inherent advantages, in places where the supply voltage is determined by other considerations. In factories 250 volt systems are frequently installed for furnishing power to motors, and in pleasure parks and other places that are supplied by trolley voltage, potentials of 500 volts are common. For service in such places the series-multiple arc lamp finds a wide field of usefulness.

The characteristics of primary importance—prompt and silent starting and steady burning—have been successfully attained in this type of lamp.

Since best results are obtained with an 80-volt, five-ampere arc, the lamp resistance is made adjustable, so that the lamps may be connected two in series on 220-250-volt circuits, or five in series on 500-550-volt circuits.

These lamps are designed for operation in series groups, and if for any reason one lamp has its arc broken an automatic cut-out switch short-circuits the mechanism, protecting the shunt coils and inserts an equivalent resistance. This enables the other lamps in the group to operate normally.

The small energy consumption, together with the superior quality and great quantity of light, make this lamp a close competitor of the flame-arc in places where either may be used. The comparison grows more favorable to this type when we consider its small up-keep, the carbon life being 125-175 hours per trim.

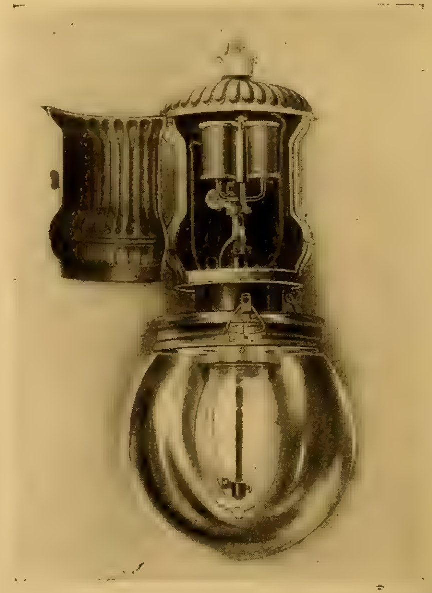


FIG. 2.—NEW WESTINGHOUSE LAMP, SHOWING MECHANISM.

Proceedings of Technical Societies

NEW METHODS AND SPECIFICATIONS FOR STREET LIGHTING, by J. H. Perkins; read at the convention of the Pennsylvania Electric Association, at Eagle's Mere, Pa., Sept. 8, 9 and 10.

Mr. Perkins reviewed the troubles that have arisen over the old "2000 candle power" rating of arc lamps, and the work of the National Electric Light Association leading up to the formation of a specification based upon actual illumination in the street.

THE TUNGSTEN LAMP IN THE RESIDENCE, by John Vandervliet; read at the Michigan Electric Association convention, at Detroit, Mich., Aug. 17, 18 and 19.

The special object of the paper was to show the incongruities and their attendant disadvantages in using the tungsten lamp on the ordinary old style fixtures, and to urge central stations to look after the interests of their patrons by showing them the proper use of this new lamp, which he considered the salvation of electric lighting as against gas.

THE SUPREMACY OF THE TUNGSTEN LAMP, by E. G. Berg; read before the Michigan Electric Association convention, at Detroit, Mich., Aug. 17, 18 and 19.

Mr. Berg reviewed the remarkably rapid rise of the tungsten lamp, and dwelt upon the numerous advantages to be obtained from its use.

THE TUNGSTEN LAMP, by D. F. Fisher, Jr.; read before the Michigan Electric Association convention.

Mr. Fisher treated the subject in a similar manner to Mr. Berg, particularly dwelling upon the short space of time from the introduction of the tungsten lamp to its commercial supremacy.

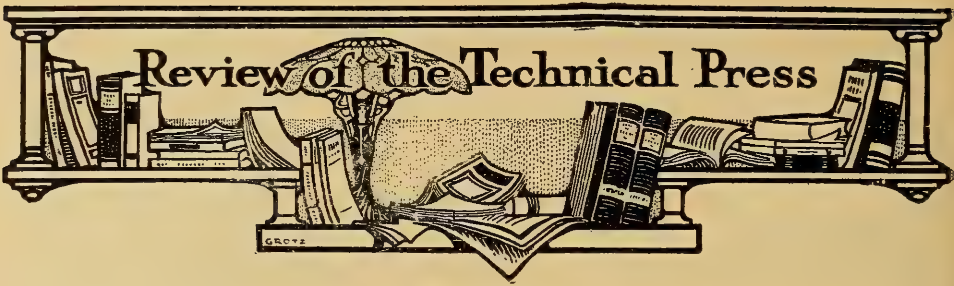
ILLUMINATING ENGINEERING PROBLEMS WITH GAS, by Norman Macbeth; read before the Michigan Gas Association convention, at Detroit, Mich., Sept. 14.

Mr. Macbeth makes a careful analysis of the comparative costs of gas and electric illumination, giving the results in several different forms to appeal to those viewing the subject from different points of view. He then proceeds to describe in detail a number of actual installations, giving all the details with his usual minuteness. The paper contains a great deal of matter which justifies the most careful consideration by all interested in promoting the cause of gas lighting; in fact, it forms a brief textbook on the subject, which should be in the possession of every gas company solicitor.

MODERN INCANDESCENT LAMPS AND IMPROVED LIGHTING, by E. L. Sherwood; read before the convention of the Northwestern Electric Light and Power Association, Seattle, September 8.

Mr. Sherwood gives a rather comprehensive review of the recent improvements in incandescent lighting, accompanied by diagrams, illustrations and curves. By way of introduction he says:

Within the past four years we have seen the beginning of a new epoch in the history of the lighting industry, brought about primarily by these wonderful improvements—the culmination of successful scientific investigations here and abroad to find a more efficient substitute for the old carbon filament.



AMERICAN ITEMS.

Electrical World; annual lighting number, Sept. 2, contains following articles treating especially of illuminating engineering topics:

Street Lighting for Small Towns, by J. R. Cravath; Street Lighting in New England; Special Street Illumination in Chicago; Street Lighting Conditions in Boston; Show Window Lighting for the Small Merchant; Shoe Store Window Lighting; Roller Coaster Illumination by Flaming Arcs; Large Animated Signs in New York City; Dry Goods Store Window Lighting; Special Illumination at Fort Wayne, Ind.; Show Window Lighting in Chicago; Window Lighting in New York City. About half of these articles are short notes.

Spacing of Light Units, by Alfred A. Wohlauer; *Electrical World,* Sept. 16.

A mathematical discussion of this subject, to which Mr. Wohlauer has given special attention.

Lighting of New Atlanta Auditorium, by James O. Spear, Jr.; *Electrical World,* Sept. 16.

A carefully prepared description, giving illustrations and results of illuminometer measurements.

The Electrical and Mechanical Installation in the Hotel La Salle, Chicago, by Howard Ehrlich; *Electrical Review and Western Electrician,* Sept. 4.

A description of the lighting installation includes illustrations of the handsome chandeliers and standards used in the dining room and banquet hall.

The Electrical Review and Western Electrician; electric lighting and illuminating engineer number, Sept. 11, contains the following articles:

Problem of Domestic Lighting, by Dr. Louis Bell; Commercial Tests on Systems of Illumination, by A. L. Eustice; Developments in Arc Lighting, by A. J. Mitchell; The Illuminating Engineer, by S. E. Doane; Tungsten Sign Lighting, by Henry F. Schroeder; The Illumination of Mills and Factories with Small Units, by E. B. Rowe and Frank B. Rae, Jr.; Westinghouse Series Tungsten Lighting System; Progress in the Westinghouse Nernst Lamp System, by Max Harris.

Dr. Bell's discussion is in his usual happy manner, and with all the valuable information given is more diverting than the product of the professional jokesmith. It is useless to attempt an abstract, but the following will serve as examples:

House lighting, despite its intimate relation to the life of people at large, is upon the whole the most neglected branch of artificial illumination. One would suppose that, considering the fact that a man has to pay lighting bills all his days, he would make every effort to get his money's worth and would go to some trouble to obtain the best possible results. In fact, however, the average man merely confines his efforts at betterment to kicking about the quality of the light and protesting at the amount of the bills, while the average woman, who is the

more important factor of the domestic situation, adds to the grumbling chorus some items to the effect that any form of lighting specified by mere man is hopelessly inartistic. As a result house lighting is too often inefficient, expensive and garish.

Mr. Eustice's article is a continuation of the subject to which he has been giving particular attention during the past year. He calls particular attention to erroneous methods of making illumination tests, and gives rules for correct practice. It is difficult to abstract the article without giving misleading impressions.

ELECTRICAL ILLUMINATION OF INDUSTRIAL PLANTS, by J. Morton Hall; *Southern Electrician,* September.

Especially describes the lighting of machine shops of the Central Georgia Railroad.

OFFICE BUILDING LIGHTING, by Albert J. Marshall; *Southern Electrician,* September.

Mr. Marshall lays special stress upon the hygienic effect of light.

NEW CAR LIGHTING EQUIPMENT ON CANADIAN PACIFIC, by J. A. Shaw; *Railway Electrical Engineer,* September.

Describes the electrical equipment and the illuminating system used on the new sleeping and compartment cars on this road.

THE TUNGSTEN LAMP, by B. F. Fisher; *Railway Electrical Engineer,* September.

A summary of the properties and uses of this form of lamp.

ADVERTISING GAS ILLUMINATING BUSINESS, by "Inspector"; *American Gas Light Journal,* Sept. 6.

Gives suggestions for an historical exhibit of light sources.

THE VARIED UTILIZATION OF GAS LAMP-POSTS, by "R"; *American Gas Light Journal,* Sept. 16.

Suggests several various uses for lamp-posts.

HYGIENE OF THE EYE, by Albert J. Marshall; *Light,* September.

This is Chapter VII. of Mr. Marshall's series on the subject of light and illumination. It is devoted chiefly to an argument on Mr. Marshall's favorite subject of light vs. dark symbols in printing.

Foreign Items

COMPILED BY J. S. DOW.

ILLUMINATION.

FORTSCHRITTE DER STRASSENBELEUCHTUNG, by Dr. L. Bloch (*E. T. Z.,* July 29, Aug. 5, 12).

Summarizes the most recent progress in street lighting, both gas and electric, with diagrams of the illumination produced under different circumstances.

THE SIMPLE EXPLANATION OF PHOTOMETRICAL TERMS, by Dr. L. Bloch (*Illum. Eng.,* London, August).

The author seeks to find a concrete analogy by the aid of which to explain fundamental photometrical ideas to the non-technical public. He endeavors to illustrate the distribution of light in space by reference to a sand blast throwing out sand in all directions, but with varying force, and shows how the chief photometric laws can be deduced on this basis.

ON THE NAME OF THE INTERNATIONAL UNIT OF LIGHT, by A. Blondel (*Illum. Eng.,* London, August).

M. Blondel points out that, agreement having now been arrived at in France, Great Britain and the United States regarding the value of the proposed international unit, a satisfactory international *name* for this unit is desirable. He therefore proposes the use of some Greek term, such as "pyr" or "Phos," or the name of

a scientist, such as "Violle," which might be contracted to "Vi."

MODERN METHODS OF ILLUMINATION, by L. Gaster.

This series of Cantor lectures, delivered before the Royal Society of Arts, is now appearing in the *Journal* of the society (Aug. 6, 13, 20, 27, Sept. 3, 10).

LIGHT IN WORSHIP, by Dr. M. Gaster (*Illum. Eng.*, London, August).

The author traces the evolution from the worship of light to the introduction of light as a part and portion of the religious worship, illustrating his conclusions by reference to the religious cults in many different parts of the world.

ANNUAL REPORT ON THE MEDICAL INSPECTION OF CHILDREN IN THE SCHOOLS OF LONDON, by Dr. J. Kerr.

This report contains some account of the experiences of inspectors of schools in London, who have studied, among other matters, the eyesight of the children and the conditions of illumination therein. Special attention is drawn to the effect of fine needlework in causing not only eye trouble, but also nervous defects, and it is suggested that the artificial illumination available in schools is rarely, if ever, sufficient to enable fine work of this kind to be done; even daylight conditions are not satisfactory during a large part of the year.

LONDON'S ELECTRIC LIGHT STANDARDS. . . . A STUDY IN INCONGRUITY! (*The Builder*, Aug. 26).

The article criticises the electric light standards and other fixtures in the streets of London, pointing out that modern forms often suffer, from the artistic standpoint, when compared with the types of more ancient times.

PHOTOMETRY.

THE PHOTOMETRY OF DIFFERENTLY COLORED LIGHTS, by Abady, Wild, Lauriol (*Electrician*, July 30, Aug. 6; correspondence).

Correspondence dealing with the recent article by Wild in the same journal; in this he finds that flicker and equality of brightness photometers give different results when applied to the comparison of tungsten and carbon filament lamps. Abady points out that it is incorrect to assume from these tests that the readings of a flicker photometer are necessarily more incorrect than the other type; in heterochromatic work the results of using *both* types of instruments are to some extent arbitrary. Lauriol refers to some of his work as a corroboration.

SULLA FOTOMETRIC ELLETTROTECNICA, by U. Bordoni (*Atti della Assoc. Elettr., Italiana,* May-June, 1909).

An exceptionally complete article mainly summarizing the present position of color photometry. The author attempts to collect present results rather than attempt much criticism, but assembles a valuable series of references to up-to-date literature.

HEFNERLAMPE U. ZEHNKERZEN-PENTANLAMPE, by E. Brodhun (*J. f. G.*, July 31; THE SO-CALLED INTERNATIONAL UNIT OF LIGHT, by H. Krüss (*J. f. G.*, Aug. 14, *J. G. L.*, Aug. 17).

Two articles mainly concerned with the recent agreement on the international unit. Brodhun reviews the merits and demerits of the Hefner and Pentane standards, seeking to justify the conviction in Germany that the former is the most reliable standard in use, and that, therefore, any unit adopted ought to be based primarily on this value. Krüss takes the attitude that, although from a practical standpoint the present agreement is satisfactory, it is not logical to speak of an international unit as yet, since such a unit can strictly only be derived from an *international standard.*

NEUERE FORTSCHRITTE AUF DEM GEBIETE DER SELENPHOTOMETRIE, by E. Presser (Schweiz, *E. T. Z.*, Aug. 14).

The author gives some account of the researches of earlier workers who have sought to apply the selenium cell to photometry. The irregularities of such cells, even under the best conditions, render it almost impossible to secure any good service from them for direct photometry.

But for strictly comparative measurements they may be put to good use, and in the case of lights of the same color. Their use for color photometry is more open to objection, but the author points out that heterochromatic measurements are in any case very uncertain.

ILLUMINATION: ITS DISTRIBUTION AND MEASUREMENT, continued, by A. P. Trotter (*Illum. Eng.*, London, August).

The author describes a form of adjustable lamp holder, enabling a glow lamp to be conveniently held in position, and centered over the photometrical bench. He also describes a very convenient form of recording apparatus, by which photometrical readings are automatically registered, their mean being subsequently obtained by a graphical method. Lastly, some attention is given to the subject of screening stray light. It is, the author thinks, usually unnecessary to insist on all parts of a room being made perfectly black.

ELECTRIC LIGHTING.

NOUVELLE LAMPE À ARC, by M. Aliamet (*l'Electricien*, Aug. 7); LA LAMPE À ARC SYWA, by De Kermond (*l'Electricien*, July 10).

Two brief articles describing recent forms of arc lamps put upon the market.

UNTERSUCHUNGEN AN WOLFRAMLAMPEN, by A. and Schuster B. Beringer (*Z. f. B.*, Aug. 20); DIE KOHLENFADENLAMPE IN VERGLEICH ZU DEN NEUEREN LAMPEN MIT ERHÖHTEM WIRKUNGSGVAD, by Leonard (*Z. f. B.*, July 10, 20); LAMPES À INCANDESCENCE, by Turpain and H. Nicouleau (*La Revue Electrique*, July 30).

These articles deal in a general manner with the properties of the metallic filament lamps. The latter one is exceptionally comprehensive, and contains a number of life-curves of different makes of metallic filament lamps for various pressures.

PREPARATION DES FILAMENTS À TUNGSTEN (*l'Electricien*, July 17); GAS VS. ELECTRIC LIGHT, by H. T. Harrison (*Elec. Times*, July 8).

The author seeks to compare the costs of modern gas and electric lighting, which he finds to be, under average conditions, not far removed from each other. He, therefore, considers that in general electricity will be at an advantage, owing to its greater convenience for interior lighting. Abady, in a letter to a subsequent number of the same journal, criticises the figures put forward.

MODERNE BÜHNENBELEUCHTUNG, by Paetow (*E. T. Z.*, July 29, Aug. 5).

A long article discussing modern stage lighting conditions. The author points out the desirability of arranging for all lamps to be controllable from a central position, and explains how modern appliances enable this to be done. He also refers to a method of using indirect illumination on the stage; this is specially effective for production of harmonious scenic effects, because delicate shades of color can be easily secured by utilizing a colored reflecting surface.

DIE VAKUUM-PRÜFUNG VON GLÜHLAMPEN, by A. Pfeiffer (*Z. f. B.*, July 30).

Describes an improved method of testing the vacuum of glow lamps by the induction-discharge method.

EXPERIENCES SUR L'ARC ELECTRIQUE, by Chèveneau (*La Revue Electrique*, July 30).

An account of some experiments on oscillatory phenomena in the electric arc.

ELECTRIC LIGHTING IN GERMANY (*Electricity*, July 2).

METALLIC FILAMENT LAMPS (*Electricity*, July 2).

DIE POPULARISIERUNG DER ELEKTRISCHEN BELEUCHTUNG (*E. T. Z.*, July 22).

GAS, OIL, ACETYLENE LIGHTING, ETC.

HEAT OF COMBUSTION AND ILLUMINATING POWER OF GASES, by Sainte Claire Deville (*J. G. L.*, Aug. 10); Dr. F. Clowes on CALORIFIC TESTS FOR LONDON GAS (*G. W.*, July 31); HIGH DUTY GASLIGHTING, continued, by T. Holgate (*Illum. Eng.*, London, August.)

All the above bear on the connection between illuminating power of gases and the performance of incandescent mantles fed by them. Mr. Holgate refers to the work of Sainte Claire Deville and the light it sheds upon the connection between flame temperature and efficiency. Mr. Holgate also discusses the other chief variable quantities, such as pressure and quality of gas consumed, and shows how this necessitates careful regulation of the incandescent burner.

FORTSCHRITTE DER INVERTGASGLÜHLICHT STARKLICHT-BELEUCHTUNG, by Lebeis (*J. f. G.*, Aug. 14); INVERTED INCANDESCENT LIGHTS, by H. O'Connor (*G. W.*, Aug. 14, *J. G. L.*, Aug. 24).

Both these communications deal with the most recent progress in inverted incandescent gas lighting. Among other points O'Connor refers to the value of small mantles which, for a given gas consumption, frequently yield a greater efficiency than those of a much larger size. He also emphasizes the connection between the design of a burner and the quality of the local gas; for instance, a burner which is quite satisfactory in one district may be a failure in another. Lebeis makes this same suggestion and describes a thermal "aerostat," an apparatus which is claimed to enable the access of air to be regulated according to the quality of gas and the time the gas has been burning.

THE TWIN LIGHT BURNER (*G. W.*, July 31).

An ingenious device in which two mantles, one upright and one inverted, are fed from the same pipe and burned. The upright mantle is placed immediately above the inverted one, and apparently the products of combustion of the latter are allowed to pass up and heat the former; indeed, it seems to be apparently possible to run both mantles with a supply of gas which would normally suffice only for one. The scientific explanation of the action of this burner seems a puzzle, but the apparatus is said to answer all right in practice.

FREE MAINTENANCE (*J. G. L.*, Aug. 24).

Refers to the action of the Croydon Gas Company, who have recently decided to undertake the maintenance of the burners of consumers free, a charge being only made for the actual cost of renewal.

METALLIC FILAMENT GAS MANTLES (*J. G. L.*, Aug. 24).

Refers to a form of mantle recently brought out and composed of metallic wire. This consists of a core of mixed metals on which is deposited a film of molybdenum. As a result a very strong and durable mantle is said to be obtained, not exceeding about 1½ in. in length. It is hoped that a useful life of as much as 2000 hours will be obtained. The mantle is credited with yielding 85 c. n. candles, at a consumtion of 2 cu. ft. and a pressure of 1½ in.

THE EFFCIENCY OF PETROL AIR LIGHTING (*Illum. Eng.*, London, August).

This number of the *Illuminating Engineer* contains the presidential address of Mr. C. Hoddle before the British Acetylene Association, in the course of which some experiences (mostly unsatisfactory) of a petrol air plant arc described. Some correspondence will also be found in this number in which several experts in petrol air lighting take part. By them it is contended that the plant used by Mr. Hoddle in his experiments is not typical of the best modern design, and that the troubles to which he refers (deposits in the pipes in cold weather, alteration in the quality of gas as more or fewer burners are turned on, etc.) do not occur in the best modern types of apparatus.

AIR-GAS AND OTHER ILLUMINANTS (*J. G. L.*, July 27).

THE APPLICATION OF ACETYLENE TO TRAIN LIGHTING (*Acetylene*, August).

HORIZONTAL GLÜHLICHT; GLOCKE FÜR GEMEINSAME GAS UND ELETRISCHE LEITUNG HÄNGENDE PRESSGAS BRENNER; KUGELGELENK FÜR GEMEINSAME GAS UND ELEKTRISCHE LEITUNG (*Z. f. B.*, July 20, 30, Aug. 10. 20).

Abbreviations used:
E. T. Z. Elektrotechnische Zeitschrift.
Elek. Anz. Elektrotechnischer Anzeiger.
G. W. Gas World.
Illum. Eng., Lond. Illuminating Engineer, London.
J. G. L. Journal of Gaslighting.
J. f. G. Journal für Gasbeleuchtung und Wasserversorgung.
Z. f. B. Zeitschrift für Beleuchtungswesen.

The
Illuminating Engineer

Vol. IV NOVEMBER, 1909 No. 9

THE MUTATIONS OF TIME

The great nations of the earth have always inhabited the temperate zone. This is the region in which nature provides the greatest amount of variation in her manifestations. Whether or not this has had a determining influence upon the development of man may be impossible to determine. It is unquestionably true that the change of season from summer to winter, with all the accompanying variety of conditions and aspects of our surroundings, is a most welcome relief from the monotony of life's routine.

The long, sunny days of summer are an invitation to get out into the open and unburden our minds from the cares and labors that have hedged it about. The sunshine tends to make nomads of us all; but as the days shorten and the darkness gathers earlier and lingers longer, our nomadic instincts disappear, and we again become gregarious.

The light of the fireside is an attractive force. We turn toward it as the flower toward the sun. Its attraction not only holds us, but, like a piece of iron in a magnetic field, we ourselves partake of the attractive force and gather others about us. Though the actual fire on a hearth-stone has disappeared, light, its very emblem and essence, has remained and increased a hundred-fold; so that our homes are more cheerful and more inviting in the present age than ever before.

The outer darkness is but another wall beyond the material one, which cheers us with the added sense of isolation and security. The light within is the very soul of peaceful joy, of hospitality, or inspiration to thought and conversation.

Welcome the dark days, with their long, cheerful, home-lit evenings! We have been primitive for a season; let us now be social beings and enjoy the luxury of companionship and the inestimable blessing of light.

Let us have more light!

E. L. Elliott.

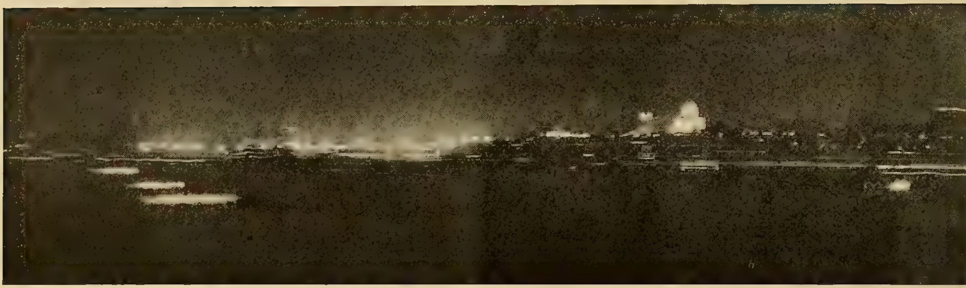


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FIG. I.—RIVERSIDE DRIVE FROM SHADYSIDE, N. J.

Illumination Features of the Hudson-Fulton Celebration

When Henry Hudson sailed his queer little Dutch boat into New York Harbor three hundred years ago the best light which he could possibly have had was a wax candle, or a smoky little oil lamp. Fulton, two hundred years later, could have had nothing better, except that his oil lamp might have been supplied with a glass chimney. The "Halve Meane" was a poor little craft indeed, but it sufficed in its time for the accomplishment of great deeds. The "Clermont" panting under a speed of four miles an hour, would be of little service to-day, but it was a revolutionary achievement a hundred years ago.

As the "Halve Meane" and the "Clermont" are to the modern steamship, so are the light-sources of their times to the artificial luminaries of the present day. Against the Indian's blazing pine knot torch we project a light of a billion candle-power, generated by the mysterious force of electricity.

The span of three hundred years, and even to a greater degree of a hundred years, has indeed been one of remarkable scientific progress. Further consideration of the history of this period brings out the fact that by far the larger part of this wonderful progress is consigned to the domain of physical science. In literature, in art, in human philosophy, in jurisprudence, who will say that we can do bet-

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FIG. 2.—THE WATER GATE, ONE HUNDRED AND TENTH STREET.

FIG. 3.—VIEW FROM THE METROPOLITAN TOWER, SHOWING THE THREE BRIDGES IN OUTLINE.

ter to-day than could our ancestors a hundred or three hundred, or one thousand years ago? Are we quite sure, that, upon the whole, we have achieved a higher morality? The one potent fact is, that we have conquered the forces of nature and

FIG. 4.—THE NEW YORK EDISON COMPANY'S WATERSIDE STATION, WITH QUEENSBORO BRIDGE IN THE DISTANCE.

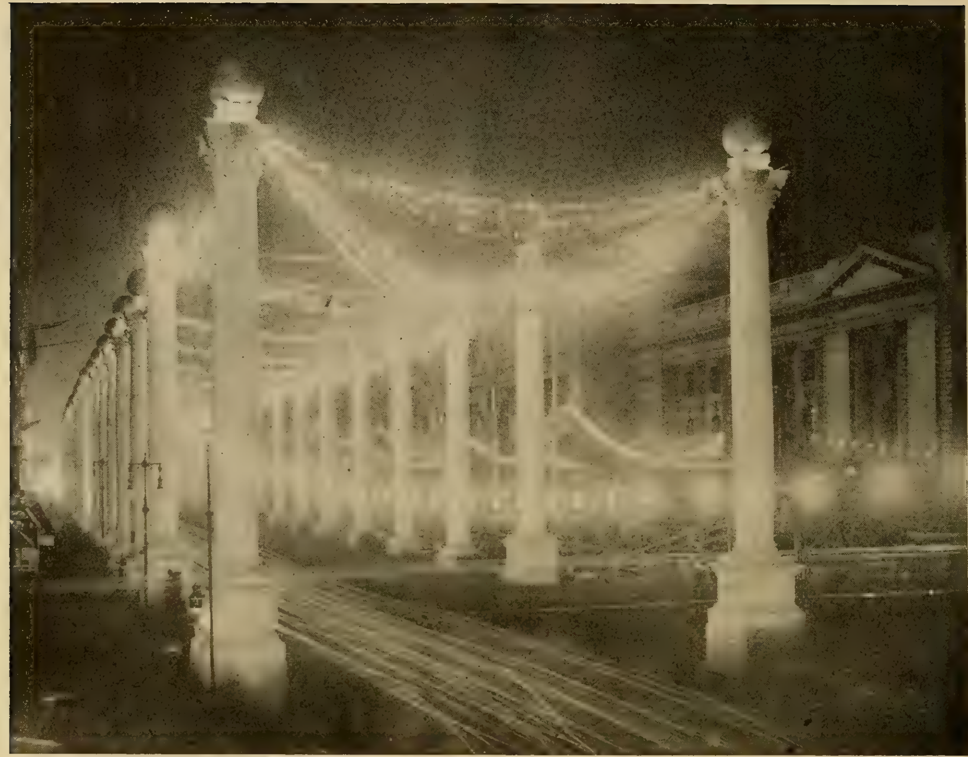

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FIG. 5.—COURT OF HONOR.

made them subservient to our use to a remarkable extent and have thereby added to human life many pleasures and possibilities for intellectual and moral development; and it must be admitted, added a compensating number of opportunities for disappointment and misery. The great and unquestioned service which science has rendered, however, is in putting within the reach or actually thrusting into the hands of the masses of the people means of enjoyment and intellectual and moral uplift, which in all preceding ages were confined to the very few. The workman, or office clerk, can to-day have precisely as good light to cheer his evening hours, or give him opportunity for study, as can any king. Science has done more to realize the equality of man than all the polemics on the subject written since the invention of letters.

Whatever is done in New York City to attract public attention must be done on a stupendous scale. In attempting, therefore, to produce a spectacular illumination that should be impressive, in connection with the recent celebration, a gigantic task was before those who had it in charge. To outline a single building of modest proportions requires ten thousand lamps: How many will it require to outline a city with a base 15 miles long?

Something of the tremendous number of lamps and the enormous scale upon which spectacular lighting would be undertaken for this event had been duly heralded before, so that those who came to see were prepared, if they did not actually expect, to see miracles. Those who were familiar with such special illuminations in connection with expositions and similar events may possibly have at first experienced a feeling of disappointment not unlike that which commonly follows the first sight of Niagara Falls. It required observations from several viewpoints, and some thought before the mind could realize the actual magnitude of the

FIG. 6.—UNION LEAGUE CLUB.

spectacle; but we venture to say that no one who saw the illumination thoroughly, went away with the slightest remnant of this disappointment lingering in his mind.

As the river itself was one of the chief things being celebrated, and the naval part of the program the most important feature, the finest effects would rightly be looked for along the river front. Figure 1 shows a section of frontage about a mile long, with the fine viaduct of the Riverside Drive outlined with lamps. The Grant monument shows above in clear cut relief, illuminated by search-lights placed at suitable points.

Fig. 2 is a view taken just above the Water Gate at 110th street, showing several of the war vessels with their outline lighting. As night photographs require a long exposure, and as there is a strong current due to the tides in this part of the river, it is generally impossible to secure a photograph that will show anything but a mere blotch. The one reproduced here shows motion in the ships, but not enough to destroy the outline. This gives but a poor idea indeed of the impressiveness and beauty of a line of modern battleships ten miles long, each ship completely outlined with lamps,—and such was the reality.

Beside the use of lamps an elaborate and extensive pyrotechnic display was made on the opening night. The picture on the cover gives some idea of the scene presented.

Turning now to the other side of the island we have a view of the city seen from the Metropolitan Tower looking toward the centre of Brooklyn. The three bridges are shown with their outline lighting.

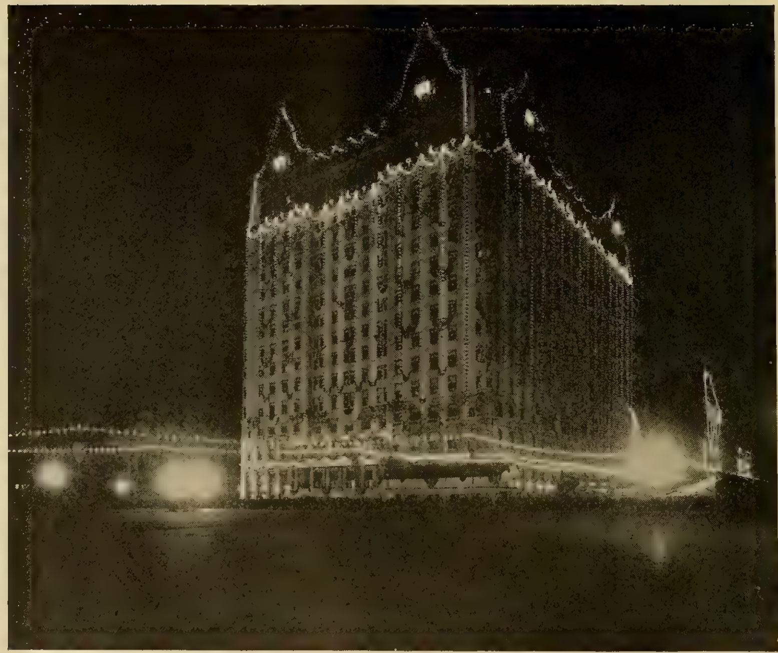


Photo by Brown Bros., N. Y.

FIG. 7.—PLAZA HOTEL.

Figure 4 is a view looking up the East River showing the Waterside Station of the New York Edison Company in the foreground, and the enormous Blackwell's Island bridge farther up. The illumination of the Waterside Station was certainly one of the finest examples of decorative lighting ever executed, and it is regrettable that for the time the station was not on the Hudson River front so that the general throng could have seen it. The photograph again is entirely inadequate to give an idea of the general beauty of the effect. The spiral winding of lamps about the huge smokestacks was a particularly happy thought.

Unquestionably the finest effect of all, however, was, as it should have been, the Court of Honor erected for the occasion, a night view of which is shown in Figure 5. This consisted of a colonnade on Fifth avenue from Fortieth to Forty-second streets, and fronting the magnificent new public library now nearing completion, which may be seen in the background. In front of this was erected the official reviewing stand. The columns and capitals are in white stucco, the globes on top being gilded. Lamps placed within the capitals illuminated these globes from below, producing an unusually pleasing and novel effect. The festoons of lamps were partly of green, the wires themselves being trimmed with leaves. From temporary poles placed on either side of the street there were festoons of lamps as far as the eye could reach, extending to Washington Square in one direction and Fifty-ninth street in the other. The regular lighting of the street, which has recently been doubled, consisting of handsome poles bearing two arc lamps each, were in regular service. The photograph in this case is a fair representation of the general beauty of the spectacle. The many light streaks apparently on the pavement will be recognized by those accustomed to photography as the paths of automobile headlights.

One of the handsome private decorations is shown in Figure 6. This is the Union League Club. Considerable use of color was made in the decorative scheme, which, of course, the photograph does not bring out. It was an exquisite piece of decorative lighting.

Photo by Brown Bros., N. Y.

FIG. 8.—METROPOLITAN TOWER.

One of the most striking and expensive pieces of outlining was that of the Plaza Hotel at Fifty-ninth street and Fifth avenue, having therefor two sides on the line of march of the land parades. This is shown in Figure 7.

There was one building which made no use of any extra outside lights, except a single one at the top, and yet presented one of the finest spectacles in the whole city. This was the Metropolitan Building, whose stately and exquisitely proportioned tower is one of the few beautiful pieces of architecture in the city. The photograph in this case is disappointing, and does not by any means bring out the fine effect which was produced by the innumerable brilliantly lighted windows. It was really one of the prettiest sights in the city. The photographer in this case gave just twenty minutes' exposure. We state this positively without having had the slightest intimation from the photographer in regard to the matter. It is only a bit of Sherlock Holmes work on our part, and at least as good as considerable that that renowned gentleman has done. Furthermore, the photograph was taken between the hours of six and 10 P. M., and the exposure began at the half hour, probably at half past eight. If you have not already seen for yourself you may now note

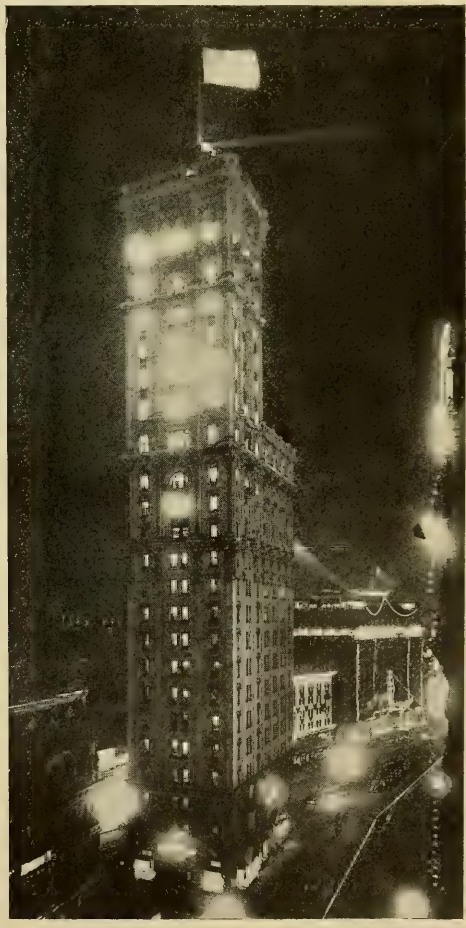


Photo by Brown Bros., N.Y.

FIG. 9.—TIMES BUILDING, SHOWING HOTEL ASTOR IN BACKGROUND.

Photo by Brown Bros., N. Y.

FIG. 10.—TIMES BUILDING, SHOWING HOTEL KNICKERBOCKER AND GREAT WHITE WAY IN BACKGROUND.

that the clock face on the tower shows a white segment extending from six to ten. This clock face, by-the-way, is the largest ever put up in this country, being thirty feet in diameter. The figures showing the hours are outlined with lamps, and the hands of the clock are illuminated in a similar manner. As the minute hand swung around it left a light space behind it in the photograph. The extent of the light space therefore marks the length of the exposure (Fig. 8).

For once the "Great White Way" was only a side show. It was not in the line of march of any of the parades, and therefore had only its own attractions to offer as an inducement to the sightseer. But who would see New York without visiting the "Great White Way"? The most brilliant and spectacular part of the thoroughfare now is the upper end about Times Square. Figure 9 is a view looking upward showing the Times Building in the foreground and the Hotel Astor just in the rear. The decoration of the latter building was exceptionally fine.

Figure 10 is a view looking down Broadway from Long Acre Square, with the Hotel Astor in the foreground at the right, and the Knickerbocker Hotel showing at the left.

The Electric Lighting of Automobiles

By Roscoe Scott.

The following pages form a general outline of present American practice in the electric lighting of motor vehicles.

In dealing with the subject, the various types of electric lamps and equipment for automobile work will be taken up and their relative efficiencies and merits considered. Recent photometric tests of interest from an illuminating engineering standpoint will be presented.

It is somewhat remarkable that the problems of automobile electric lighting, which are fundamentally engineering problems, have not been more thoroughly investigated and attacked with the aim of securing the best results in efficiency and lighting effect. Indeed, a tendency to dodge these problems entirely and to fall into ruts in the matter of equipment exists in some cases, even among manufacturers who enjoy a high reputation for the mechanical performance of their cars. Other manufacturers, realizing that automobile owners are usually fastidious in their desire that all appurtenances of their machines shall be of the most approved type, are trying to select each lamp, reflector and fixture with special reference to the purposes which it is to fulfill. The ultra-conservatives are found to follow sooner or later in the lead of the progressives.

The apparatus which we have to consider will be taken up in the following sequence: (a) electric lamps; (b) reflectors and fixtures for interior lighting; (c) reflectors and fixtures for exterior lighting; (d) electrical equipment.

(a) Electric Lamps. As in other classes of incandescent lighting work the carbon filament has until recently been "cock of the walk," but is now excelled by the tungsten filament with its greater efficiency and brilliancy. Tungsten automobile lamps, on account of the low voltage (six volts usually) at which they operate and

TABLE 1.—CARBON LAMPS USED FOR AUTOMOBILE WORK.

Mean horizontal candlepower. 1.	Volts. 2.	Watts per candle. 3.	Total watts. 4.	Style of filament. 5.	Amperes at Lowest voltage. 6.	Amperes at Highest voltage. 7.	Dimensions (Inches). Diameter. 8.	Dimensions (Inches). Length over all. 9.	Tip candlepower. 10.	Mean spherical candlepower. 11.	Mean spherical candlepower at 3.1 W. P. C. 12.	Average hours useful life at constant voltage. 13.	Base. 14.
4	20 to 90	3.8	15.2	Single loop.	.76	.17	1⅛	2¼	1.6	3.3	..	....	Cand.
6	20 to 90	3.8	22.8	Single loop.	1.14	.25	1⅛	2¼	2.3	4.9	..	....	Cand.
2	90 to 130	6.5	13.0	Double coil.	.14	.10	1⅛	2¼	0.8	1.6	6.1	3,000	Cand.
4	90 to 130	4.0	16.0	Double coil.	.18	.12	1⅛	2¼	1.6	3.3	..	....	Cand.
4	20 to 70	3.8	15.2	Single loop.	.76	.22	1⅜	2 15/16	1.4	3.3	5.5	1,600	Cand.
6	20 to 70	3.6	21.6	Single loop.	1.08	.31	1⅜	2 15/16	2.2	4.9	6.0	500	Cand.
4	70 to 130	3.8	15.2	Single coil.	.22	.12	1⅜	2 15/16	1.7	3.3	6.0	....	Cand.
5	70 to 130	3.8	19.0	Single coil.	.27	.15	1⅜	2 15/16	2.4	4.5	6.5	....	Cand.
6	70 to 130	3.8	22.8	Single coil.	.33	.18	1⅜	2 15/16	2.9	5.0	8.0	....	Cand.

TABLE 2.—TUNGSTEN LAMPS USED FOR AUTOMOBILE WORK.

Designation. 1.	Mean horizontal candle-power. 2.	Volts. 3.	Total watts. 4.	Amperes at rated voltages. 5.	Dimensions (inches). Diameter. 6.	Dimensions (inches). L'gth over all. 7.	Estimated life in hours. 8.	Base. 9.
⅝-in. tubular special cap base on each end..............	2	4	2.5	0.62	⅝	2 1/16	200	Cap.
	4	4, 6 and 8	5	1.25, 0.83 and 0.62	⅝	2 1/16	200	Cap.
	6	6 and 8	7.5	1.25 and 0.93	⅝	2 1/16	250	Cap.
	8	6 and 8	10	1.67 and 1.25	⅝	2 1/16	300	Cap.
¾-in. round (automobile tail-light)	1	4	1.25	0.31	¾	1¼	200	Min. or Cand.
	2	4 and 6	2.5	0.62 and 0.41	¾	1¼	200	Min. or Cand.
	4	4 and 6	5	1.25 and 0.83	¾	1¼	200	Min. or Cand.
1-in. round (automobile side-light)	4	4, 6 and 8	5	1.25, 0.83 and 0.62	1	1¾	200	Min. or Cand.
	6	4, 6 and 8	7.5	1.87, 1.25 and 0.93	1	1¾	250	Min. or Cand.
	8	4, 6 and 8	10	2.5. 1.66 and 1.25	1	1¾	300	Min. or Cand.
1½-in. round (automobile head-light)	8	6 and 8	10	1.66 and 1.25	1½	2⅜	300	Cand.
	12	6 and 8	15	2.5 and 1.62	1½	2⅜	300	Cand.
	16	6 and 8	20	3.3 and 2.5	1½	2⅜	300	Cand.

the smaller number of cells in series thereby made necessary, and also because of their greater brilliancy, have extended the field of automobile electric lighting so that it is now on a practical basis not only for electric carriages, but for vehicles of all kinds, regardless of the method of propulsion.

The lamps used, being of the miniature style, are practically always furnished with the American Edison candelabra base (⅝ in. long by 7-16 in. diameter) or the American miniature base (7-16 in. long by ⅜ in. diameter). The candelabra base is by far the more commonly used since it is larger and stronger, and is to be preferred in all cases to the miniature base. The Standard Edison base (1 in. diameter) is occasionally used for headlights.

I have tabulated (see Tables 1 and 2) certain types of carbon and tungsten lamps which are among those most extensively used in automobile work.

Carbon automobile lamps are used for electric vehicles mainly, and are seldom required for voltages lower than 28 or higher than 85, as the storage batteries in common use consist of 14, 24, 28, 30, 40 or 42 cells. Frequently the lamps are arranged to operate on one-half the total voltage of the battery.

The method of supporting the tungsten filament shown in Fig. 3 is known as "anchoring back." It is used for all tungsten round bulb automobile lamps, and is the strongest commercial method of mounting, as regards the ability to resist breakage due to jarring of the lamp. The anchored-back mount, in conjunction with the naturally thick low voltage filament, has proved its ability to counteract, in actual service, the brittleness of tungsten wire as hitherto developed.

The anchored-back mount has the additional advantage for headlights having parabolic reflectors, that it confines the filament in a comparatively small space, the center of which may be made to coincide with the focus of the parabolic surface of revolution.

(b) Reflectors and Fixtures for Interior Lighting.—Interior lighting, including limousine lighting, while omitted entirely on many machines, may be considered one of the requisites of large luxurious cars. It is also generally found in electric coupés.

The equipment used for interior lighting varies a great deal with the different makes. Many electric vehicles employ clear carbon lamps with no reflectors, while certain engine-driven cars are equipped with reflectorless frosted bulb tungsten lamps.

FIG. 1.—BASES.—A.—AMERICAN EDISON CANDELABRA, 7-16 x ⅝ IN., 10 THREADS TO THE INCH. B.—AMERICAN EDISON MINIATURE, ⅜ x 7-16 IN., 14 THREADS TO THE INCH.

FIG. 2.—6 C. P. CARBON, 20 TO 70 VOLTS.

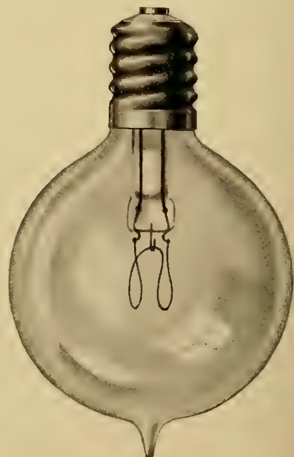


FIG. 3.—16 C. P. TUNGSTEN, 6 VOLTS.

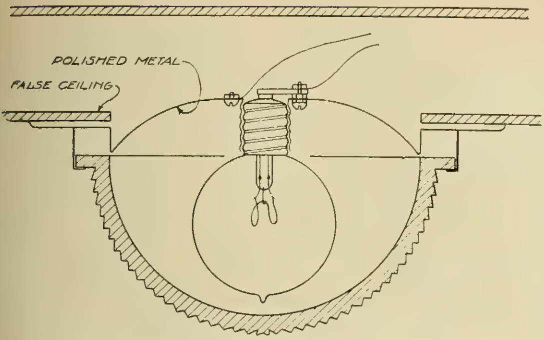


FIG. 4.—DOME LIGHT USING TUNGSTEN 1½-IN. ROUND LAMP WITH HOLOPHANE REFLECTOR. HALF SIZE.

The lamp designated in Table 2 as "⅝-in. tabular" is used in the lighting of limousine bodies, being connected to a special holder, which is located in the ceiling of the limousine and provides a contact at each end of the lamp.

Another excellent method of lighting limousines consists in the use of clear tungsten automobile lamps (like those listed in Table 2), equipped with bowl-shaped prismatic glass reflectors, the complete unit being known as a dome light. Dome lights are attached to the false ceiling of the car and should always contain a polished metallic surface above the lamp for throwing light, which would otherwise be lost, down through the reflector. One arrangement which has been used for such a fixture is shown in Fig. 4. It will be noted that a special arrangement for holding the lamp is used, which make it unnecessary for a lamp socket or receptacle to be screwed to the ceiling, as the holding device is attached directly to the back part of the reflector.

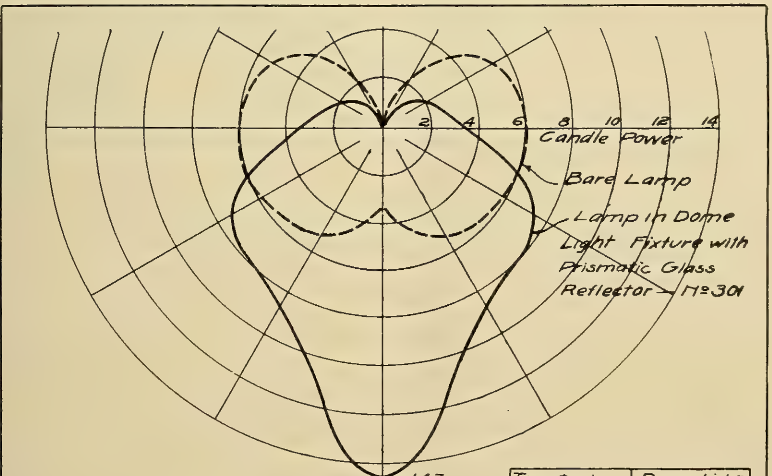
The only objection to the use of dome lights has been the necessity of cutting holes in the false ceiling of the limousine. On this account the larger types of bowl reflector are not as popular as the smaller types. A complete table of commercially available sizes is given below:

TABLE 3.—HOLOPHANE BOWL REFLECTORS FOR DOME LIGHTS.

Designation.	Candlepower Tungsten lamp for which reflector is designated.	Outside diameter of glass bowl. Inches.	Depth of glass bowl over all. Inches.
"No. 301"	6	3¼	1⅝
"No. 401"	8	4½	1¼
"No. 411"	8	4	1¾
"No. 511"	12	3¼	1⅝
"No. 611"	16	5⅞	2¾

Fig. 5 shows *the polar distribution of

* Fig. 5 is based on recent tests by the Engineering Department of the National Electric Lamp Association.



	Tungsten Lamp Alone	Dome Light Unit
Mean Spherical C.P.	5.1	4.36
Mean Hem. C.P.	5.63	6.88

Distance from Light Source to Photometer Head along Path of Ray = 12 feet

FIG. 5.

FIG. 6.

candle-power around a dome light consisting of a 6 c. p. tungsten lamp in a 1-in. round bulb, equipped with the bowl reflector designated in Table 3, as No. 301. A polished metal reflector was used above the bowl. The complete unit is shown in Fig. 6. A dome light of this kind furnishes sufficient light for reading purposes.

The salient features of dome lighting for limousines are the following:

(1) A good diffusion of the light from the tungsten lamp, which would otherwise be tiring to the eyes on account of its extreme brilliancy.
(2) A fairly even distribution of the light over the plane to be illuminated.
(3) Excellent color quality of the light.

The superiority of electric lighting for the interior of vehicles seems to be unquestionable, since in this service one cannot put up with any apparatus that is likely to smoke or smell.

While not strictly a lamp for interior lighting, the meter or speedometer light may be here mentioned. Fig. 7 illustrates one type of meter lamp, with its reflector, and shows how the direction of the light may be adjusted. A 4 c. p. lamp gives an abundance of light for this purpose. Tungsten automobile lamps are adapted for use in the meter light as well as in the other lights.

(c) Reflectors and Fixtures for Exterior Lighting.—We now come to the consideration of exterior lighting for automobiles. Fig. 8 (a diagram) shows the general lay-out of a car, with its outside lamps. We shall start at the front of the car and consider the headlights first.

Some owners of large cars at the present time are using electric lighting for headlights only, using oil for sidelights.

FIG. 7.

It is well known that the use of the acetylene headlight in certain congested cities has been prohibited by ordinances, and that similar action is contemplated in other cities which have not as yet taken this step. While a powerful tungsten headlight is perhaps quite as dazzling as an acetylene light, it nevertheless can easily be cut down in brilliancy by the use of electric dimming devices, and can, of course, be turned on or off without a moment's waste of time.

Fig. 9 shows an electric headlight fixture with plug for attachment to the battery lines. This fixture is an improved type, the following details of its construction being worthy of mention:

The silvered glass parabolic reflector is separated from the front glass by a dust tight felt washer, against which it is tightly pressed by a steel clamp.

The electric lamp is mounted in a hori-

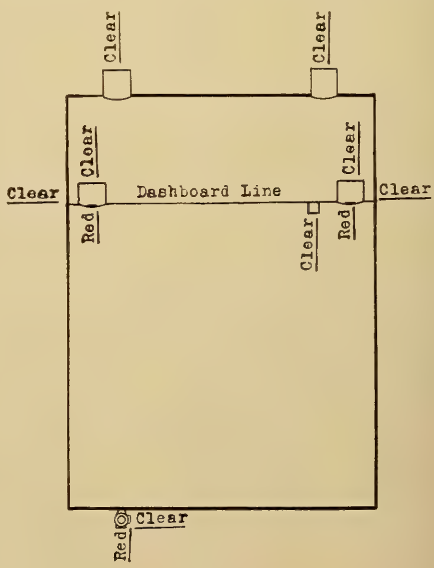


FIG. 8.—LAYOUT OF EXTERIOR LAMPS ON AUTOMOBILE.

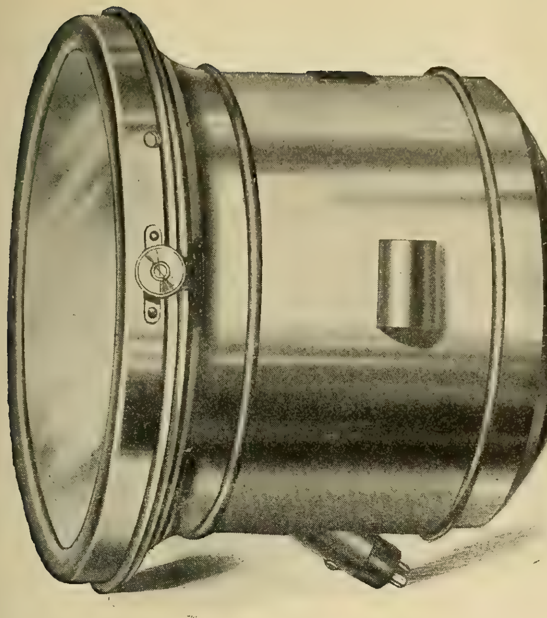


FIG. 9.

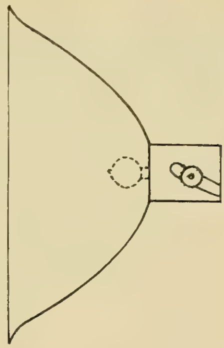


FIG. 10.

a is the angle of tip of the headlight;
H is the height of the headlight above the street;
D is the diameter of the bundle of rays assumed perfectly parallel (all other rays neglected for purposes of discussion);
P is the length of highway illuminated;
L is the extreme distance of the lighted area from the light source.

zontal socket, held in a "sliding focus." (See Fig. 10.) This gives the socket a movement of ¼ in. in and out, which is all that is required in order to adjust the focus properly. When the socket has been placed in the desired position, it is there retained by means of a thumb screw, which keeps it from slipping along in the slot.

It is not desirable, even if it were practical, that all the light from a headlight should be reflected in parallel rays, as this would result in too small an area of highway being illuminated. The point may perhaps be brought out best by an example. In Fig. 11

By geometry:

$$P = D/\sin a, \text{ and } L = H/\tan a \div P/2.$$

Assuming the following values:

H = 3 feet (an average value);
a = 10°;
D = 6 inches;

We obtain:

P = 2′, 87 only.
L = 18′, 43.

In actual practice, the light is always played out to a considerable extent, owing mainly to the unreflected rays. These increase the lighted area and invalidate the above formulæ.

Photometric tests have recently been conducted by the engineering department of the National Electric Lamp Association on the headlight shown in Fig. 9, using

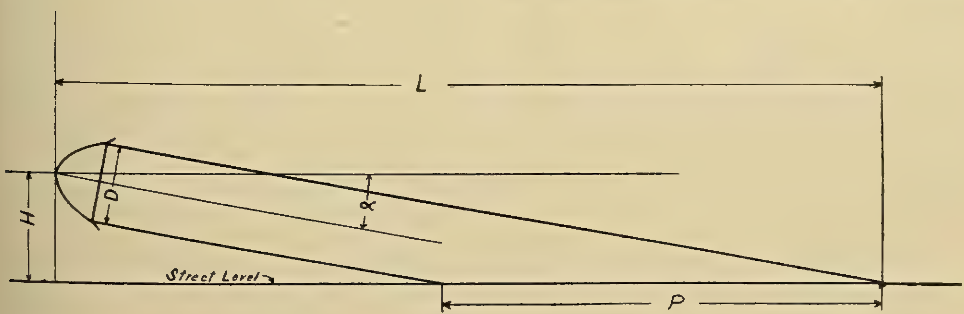


FIG. 11.

FIG. 12 CARBON HEADLIGHT

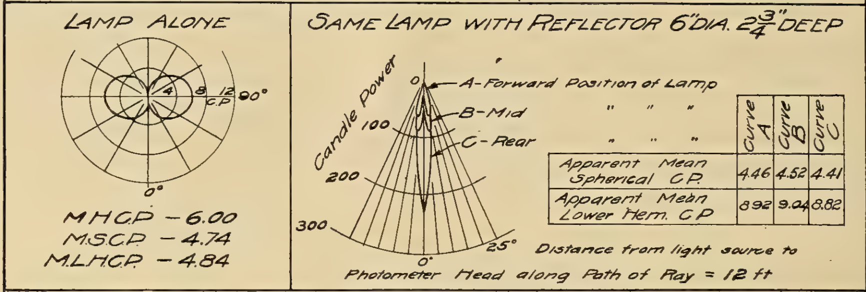
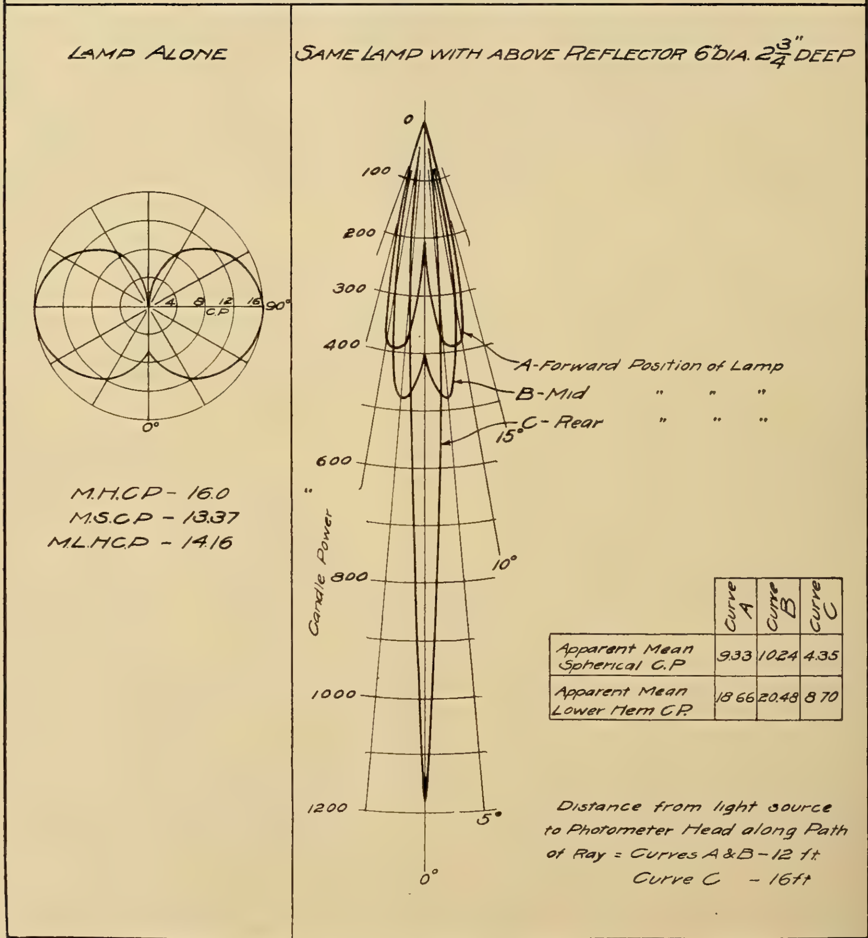


FIG. 13 TUNGSTEN HEADLIGHT



carbon and tungsten lamps. The tests (see Figs. 12 and 13) were made on:

(1) A 6 cp. carbon automobile lamp in a pear-shaped bulb, 1⅜ in. in diameter. This lamp consumed 21.6 watts at an efficiency of 3.6 w.p.c.

(2) A 16 cp. Tungsten automobile lamp in a 1½ in. round bulb. This lamp consumed 20 watts at an efficiency of 1¼ w.p.c.

The lamps were tested at both extremes and also at the middle of the sliding focus; the innermost position of the lamps, being closest to the focus, gave by far

the highest values of end-on apparent candle power in every case. The very much greater intensity of the tungsten headlight, which reaches a tip value of 1170 apparent candle power, shows up plainly in the candle power curves. Comparative figures of both mean spherical and mean hemispherical apparent candle power are given for both the carbon and tungsten lamp equipments. The distance from the lamp to the photometer screen, measured along the path of the ray of light, was 16 ft. for the reading just mentioned, as noted on the plate.

(To be continued.)

The Ryan Electric Color Scintillator

The crowning piece of all the spectacular lighting features of the Hudson-Fulton celebration was the enormous battery of searchlights located on the river front at 155th street. The Riverside Drive here bows out almost to the water's edge, thus affording a sort of promontory from which the light could be directed against the entire line of warships and river craft, as well as over a large area of the New York shore. This was undoubtedly the most powerful aggregation of light producing apparatus ever assembled, consisting of twenty of the most powerful type of modern search-lights. These were arranged in an approximate semi-circle, as near together as manipulation would permit, on a platform raised about fifteen feet above the roadway, Fig. 1. In order to realize the full possibilities of the innumerable combinations made possible by this battery, it was necessary that concerted action on the part of each operator be provided for. This was accomplished by a system of military tactics. A command was given to the director who was stationed midway in the circle of lamps. From this director it was passed to successive operators until all had it.

FIG. 1.—ARRANGEMENT OF THE BATTERY OF SEARCHLIGHTS.

FIG. 2.—VIEW OF SCINTILLATOR AT ONE HUNDRED AND THIRTY-FIFTH STREET.

The general orders were given by telephone from a station twenty blocks below.

The battery was divided into two sections, thus facilitating the manipulation. Consider that each individual search-light could produce white, blue, green, yellow and red light, and be turned independently so as to throw its beam in any direction; and consider the combinations that could be made by crossing and interweaving twenty of these beams, and you may get some conception of what could be accomplished in the way of color illumination by this battery. It is absolutely impossible to indicate it in a description or a picture.

The finest effect was that seen from a considerable distance in front of the battery. Figure 2 is a view taken at 135th street. While this gives some idea of the magnificence of the effect, it of course lacks the wonderful fascination which color and movement give to light.

In addition to the use of the sky and surrounding objects to bring out the effect of illumination, a powerful steam boiler was erected a few hundred feet from the battery, and above this there was an elaborate system of steam pipes, so that various emblems could be outlined in steam jets, and the same intensely illuminated from the light from the battery. The most striking of these emblems was that of a sailing vessel with masts, spars and hull showing clearly in dazzling white or exquisitely colored light. Other effects simulated enormous pyrotechnic devices, while still others were entirely original and unique. Altogether it was unquestionably the most gorgeous display of spectacular lighting ever produced from a single installation. The original idea and entire system was due to Mr. W. D'A. Ryan, who has been studying and developing the method for a number of years. Mr. Ryan included the whole device under the name "scintillator"—not an especially happy designation for so impressive an effect.

Lastly, a most unusual and beautiful effect was produced by sending up a bomb

which exploded when several hundred feet in the air with a loud detonation, and a puff of white smoke, at the same time liberating a large number of sheets of paper having one side glossy white, and the other side dull. The concentrating beam of the battery picked up the smoke, showing it as a glistening white patch of cloud from which could be seen falling what looked like flakes of sparkling silver confetti. These were in reality the sheets of paper, which, turning and fluttering in their descent, showed first the glittering white surface to the rays, and then their non-reflecting surface, thus producing the effect of scintillation,—the only effect, by the way, of the entire spectacle to which this word can properly apply.

Man vs. Gas in the Vitiation of Air

Does the breathing of a man vitiate the atmosphere as much as the burning of a gas jet? Much light is thrown upon this subject by instructive tests recently made by the Arthur D. Little, Inc., Laboratory of Engineering Chemistry, Boston, Mass., in a study of this complex problem of human life.

The test room was suitably arranged for air-tightness and a fan system maintained the desired degree of ventilation by exhausting the vitiated air at a rate to keep the carbon dioxide down to 7 parts in 10,000 while a man occupied the room. Samples of the air were taken from the room at intervals and analyzed with the following average results:

Carbon dioxide (parts per 10,000) before lighting gas, with one man in the room	7.00
Carbon dioxide after lighting gas, at end of one hour	11.00
At the end of two hours	11.00
Carbon dioxide in outside air	4.50
Temperature before lighting gas	55.4 F
Temperature after lighting gas, average	65.3 F

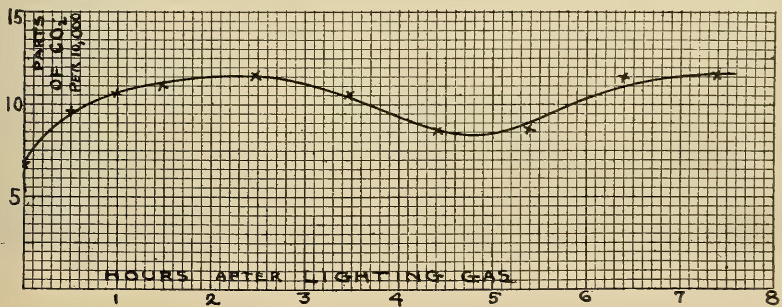
A second test was conducted under the same conditions, except that oxide gas was used instead of street gas; the term "oxide" being applied to commercial gas without lime purification.

The results of the second test were as follows:

Carbon dioxide (parts per 10,000) before lighting gas, one man in the room	6.5
Carbon dioxide after lighting gas, at end of one hour	9.5
At end of two hours	10.5
At end of three hours	11.0
Temperature before lighting gas	50.0 F
Temperature after lighting gas, average	50.0 F

From these tests it will be seen that in a fairly well ventilated room the presence of a man caused an increase in the carbon dioxide content of 2 to 2½ parts, while the combustion of gas in addition raised the amount of carbon dioxide 3½ or 4 parts. During these tests the man remained comparatively quiet, but had he moved about actively the amount of carbon dioxide given off by his respiration would have been much greater, probably as much as 4 cubic feet per hour, while a man expires only one-half cubic foot when asleep.

The accompanying curve shows the effect of respiration and the combustion of gas on the carbon dioxide content. The data for this curve were obtained from the second test, the time of beginning being coincident with the lighting of the gas.



Practical Problems in Illuminating Engineering

The Lighting of a Tailor Shop

By Norman Macbeth.

Many of the points were well taken in the two answers to the question "What Would You Do?" asked in your August number and answered for Nernst in September and Tungsten in October. However, as this room was properly piped for gas, there would seem to be no good reason why gas should not be used, especially as all the specifications and good points in the preceding answers can be met with a moderate gas equipment in addition to advantages exclusively in favor of gas.

"The room . . . . receives its daylight entirely from two large windows in the front." The Nernst switch control, therefore, requires the use of two lamps in the center row, one of which is within fifteen feet of these windows; should it be desired to have one lamp burning in the rear of this room during the daylight hours, or if the other circuit is used, then the two lamps suspended over the clothes

FIG. I.—THE TAILOR SHOP.

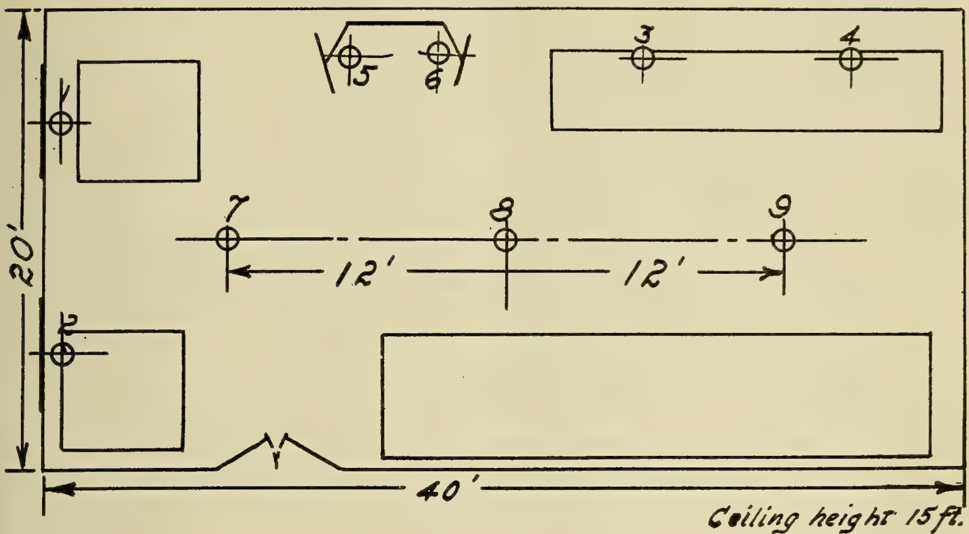


FIG. 2.—PLAN FOR OUTLETS.

racks would be on when the two lamps over the cutting table only were required.

Neither the Nernst nor tungsten answer provided for the illumination most necessary at the mirrors. The adoption of either plan would result in the direction of light upon a form being all from the rear. This particular part of the lighting is unquestionably of the utmost importance. Many coats have been thrown back on a tailor's hands for alteration because of a small wrinkle or pucker (not otherwise particularly serious), which under daylight would not be noticed, but when viewed under artificial light of moderate intensity and single direction were considerably exaggerated.

A highly diffused light properly directed from both front and rear will cause a wrinkle on the shoulder or about the collar, two very important points, to either be not observable or so softened as to be readily overlooked. On a recent installation where this question was most forcibly brought up the tailor emphasized this point, stating that he wished to be the judge as to whether a wrinkle was serious or not, and that he had been subjected to considerable expense and delay in deliveries through the failure of lighting contractors to appreciate its importance and suitably provide for same.

Outlets Nos. 5 and 6 (Fig. 2) should, therefore, be equipped with inverted lamps, with enclosing globes of sufficient density to ensure low intrinsic brilliancy. These lamps should be placed over the two corners of the rear section of the mirrors and forward about 6 in. They would thus be out of the line of vision of a customer and out of the line of direct reflection from the mirrors to his eye, while effective on that portion of the form toward the mirrors. Globes of the density necessary to soften this light down to the same effective intensity as that received from outlets Nos. 7 and 8 would not be difficult to secure.

Assuming the average intensity used in the previous solutions, viz., 6 foot-candles, with artificial gas as supplied in New York City at 80 cents per 1000 cu. ft., and a duty from reflex lamps with opal or prismatic reflectors, light ceiling and dark walls, of 100 lumens per cubic foot per hour. The area, 20 ft. by 40 ft., of 800 sq. ft., would, therefore, require 800 times 6, divided by 100, equals 48 cu. ft. of gas per hour, and with a nominal consumption of $3\frac{1}{3}$ cu. ft. per lamp, 14.4 lamps.

Referring to the plan Fig. 2, outlets 1 to 6 should be single lamps and 7 to 9 three lamps per outlet, or 15 lamps in all. Lamps Nos. 3 and 4 should be at a height of approximately 5 ft. 6 in. above the cutting table, and placed as shown by plan

Fig. 2; otherwise, very objectionable shadows will result on the cutting table. Nos. 1 and 2 may be placed central in the window, their apparent purpose, in addition to their contribution to the illumination inside, being to show from the street that the store is open for business. The lamps on outlets Nos. 7, 8 and 9 should be suspended 10 to 12 ft. above the floor, which, with the distance between outlets of 12 ft., will ensure a high degree of diffusion.

The appropriation for fixtures with this equipment could readily be quite handsome and still considerably underbid the electric propositions, where the expense for wiring must be considered. The lamps, at the outside $2.50 each, would not exceed $37.50, and the summary, assuming the average use of 100 hours per month, would, therefore, be as follows:

Consumption cubic feet on 15 lamps, at 3.3 cu. ft. 50
Total consumption per month...... 5000
Cost of gas per month, at 80 cents per thousand....................$4.00
*Cost of maintenance per month, at 20 cents per mantle.............$3.00
Total operating cost per month.....$7.50

As it was not stated that this store was located in New York City, it may be assumed that natural gas is available, and at the average cost of 30 cents per 1000 cu. ft.

Owing to the higher calorific value of natural gas, the intensities would be 20 per cent. higher than for the artificial, or slightly over 7 foot-candles average, and the consumption with reflex lamps 20 per cent. less than with artificial gas, or 2.66 cu. ft. per hour.

The costs would then be:

Consumption cubic feet on 15 lamps, at 2.66 per lamp................ 40
Total consumption per month...... 4000
Cost of gas per month, at 30 cents per thousand...................$1.20
Cost of maintenance per month, at 20 cents per mantle.............$3.00
Total operating cost per month.....$4.20

* This is a maximum figure, many maintenance companies charge as low as 10c. per mantle per month, with weekly inspections.

Billiard Table Lighting

The artificial lighting of a billiard table is one of those small problems in illuminating engineering, the difficulty of solving which seems out of proportion to its relative importance. A billiard table satisfactorily lighted artificially is one of the rarest occurrences in the whole subject of lighting. The difficulties of the problem, or at least the general dissatisfaction with results, is evidenced by the endless number of ways in which the problem is attacked. There are hardly two installations alike. Lamps of every size, kind, and description, and in any number from 1 to 6, may be found in use in connection with all sorts of globes and reflectors.

The conditions are exacting. The surface of the table and the cushions, which are of green cloth and slightly absorbent of light, must show a good degree of intensity, which must be absolutely uniform. Beside this, the balls should cast no distinct shadow in any direction. These conditions must be fulfilled with light-sources screened from direct vision and out of the reach of the cues of the players.

The illustration shows a solution of the problem by a well known electrical supply house in Ohio, which has the distinction of being the first of its kind to maintain an illuminating engineering department. If the character of its engineering staff may be judged from its solution of this problem, it can certainly be trusted with any other problems that may be brought before it. The fixture uses 40-watt tungsten lamps with concentrated prismatic reflectors. It is hung at a sufficient height to give freedom for cue play, and the bowl-shaped reflectors sufficiently protect the eyes from direct glare. The photograph is the best evidence as to the results. Note the perfect evenness of illumination (there is a discoloration on the

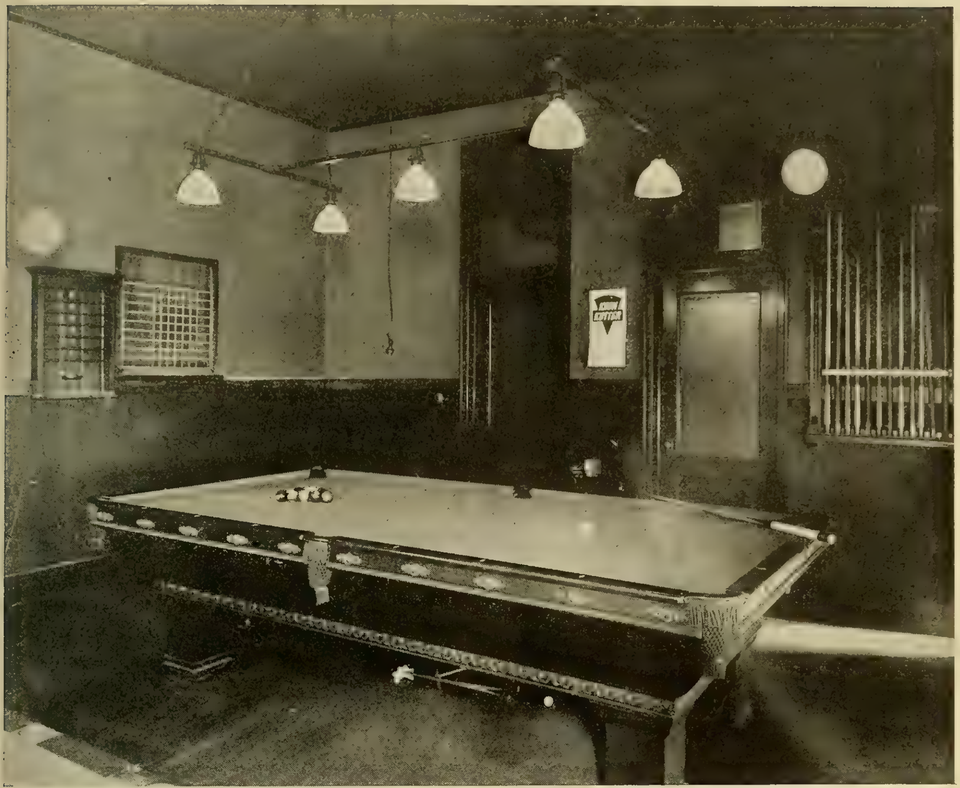
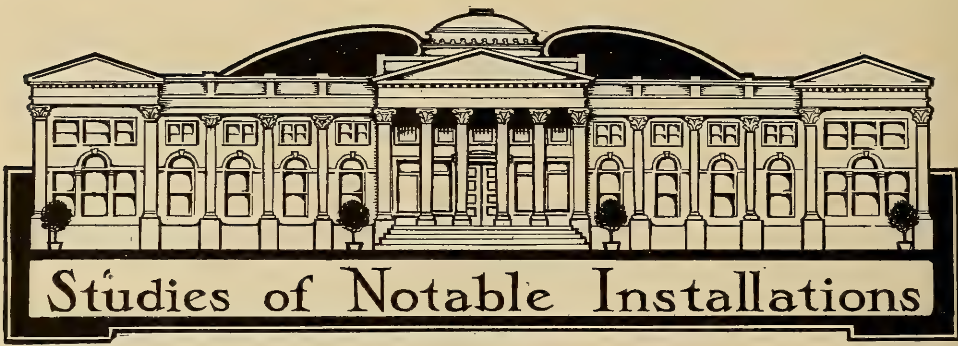


FIG. I.—AN EXAMPLE OF BILLIARD TABLE LIGHTING.

photograph at the right, which should not be taken into account) but what is more important, observe that the ball stands out perfectly distinct without an apparent shadow in any direction.

There may be other good ways of lighting a billiard table. It is positive that the method here indicated is a complete success, and may be adopted with perfect confidence by those having such installations to install.

Here is a suggestion for lighting a billiard table which has at least the merit of an absolute novelty. It may be only a wild-eyed inventor's dream, but sometimes these dreams come true. Suppose, instead of making the top of the billiard table of slate, according to the general practice, it were made of plate glass; and instead of being covered with the regulation green cloth it were covered with white, the cushions being left green as at present. Then suppose electric lamps arranged underneath in such a way as to give a perfectly even illumination through the glass top of the table and the white cloth cover. We may then assume that the room itself would have a very mild general illumination, preferably with indirect lighting. This would surely furnish an illumination that was absolutely shadowless, and without glare or even the visible presence of a light-source. Is the scheme practical? Some of our billiard playing friends can perhaps tell us.



The Assembly Room of the South Shore Country Club, Chicago

The South Shore Country Club is one of Chicago's largest social institutions, having a membership of some 2000. Its magnificent building is situated in a private park containing 60 acres, fronting the lake at Seventy-first street. Nearly a million dollars have recently been spent in improvements, chief of which is the magnificent new assembly room, which was designed by Marshall & Fox, the architects of the Maxine Elliott Theatre, New York, the illumination of which received favorable review in a previous issue of this publication. The room occupies a separate building, which is connected by a passageway to the main house. The building itself is 86 x 124 ft. The main ceiling is supported by 30 Ionic columns, and has a promenade 12 ft. wide around all four sides. The central ceiling is 28 ft. high, while the ceiling of the promenade is 20 ft. The ceiling of the promenade is divided into 12-ft. panels, of which there are 28, while the main ceiling has a single panel, as shown. The finish is in old ivory and gray, with draperies in American beauty red. The building is used for balls, concerts and social gatherings.

The problem of illuminating this exceptionally handsome, classical, and rather unusual room was recognized as a matter of prime importance by both the club and the architect. On the part of the former Mr. Frederick Bode, the President, and Mr. B. F. Winston, Chairman of the Building and Grounds Committee, who were both abroad early in the year, made a special point of investigating the illumination of similar halls in the European cities. They also pursued their investigation in the Eastern cities of this country.

The final decision fell upon indirect illumination as the system most likely to fulfill all the requirements. Manifestly such an installation required the design of special fixtures, both from the engineering and artistic standpoints. As the outlets had been located before the decision to use indirect illumination had been reached, it was practically necessary to design the system to use the outlets so provided. Instead of three large chandeliers for direct lighting as originally contemplated, therefore, three indirect lighting fixtures were substituted. These consist of 23 of the most efficient form of indirect lighting units, each using a 100-watt tungsten lamp, all being enclosed in a specially decorative hemisphere. This hemisphere is of open work design, and is lined with red silk, which shows its color by light reflected from the ceiling, thus preventing the total shadow which would otherwise obscure the design, as well as adding its own beauty. The promenade is lighted in a similar manner by fixtures containing a single indirect unit suspended from the centre of each panel.

Is this installation a success? Who are most competent to answer the question?

Assuredly those for whose use the illumination was especially provided, and who have tested it by the method which is undisputed, at least, in the case of pud-

FIG. I.—BALL ROOM.

FIG. 2.—FOYER TO BALL ROOM.

FIG. 3.—PROMENADE.

dings, have a right to be heard. The officials of the club without exception are not only satisfied, but are positively enthusiastic over the effect produced, asserting that it is superior to any other illumination which has come under their observation; and members and guests, so far as known, are unanimous in their approval. Mr. Walter Damrosch, after conducting a series of concerts here, expressed himself as delighted with the illumination, and said that half the effect of many a fine musical performance was lost by the discomfort from glaring, ill-placed light-sources.

Illuminating engineers will naturally ask for facts and figures, so here they are:

Total area of floor, square feet	10,700
Area of main floor, square feet	6,000
Height of main ceiling, feet	28
Height of ceiling in promenade, feet	20
Distance from top of reflector to ceiling in main room, feet	6
Distance from top of reflector to ceiling in promenade, inches	30
Number of lamps used in main room	69
Number of lamps used in promenade	28
Total	97
Watts per lamp	100
Total watts	9,700
Cost per hour (electricity at 8c. per K.W. H.,), cents	77.6
Watts per square foot of floor space	0.9
Intensity of illumination (estimated), foot candles	3

In visual effect it is to be noted that the finest print can be read with ease at any point in the room, and that the features may be recognized perfectly from one end of the room to the other.

It may also be of interest to state that the estimated cost of the fixture installation for direct lighting was practically twice the sum paid for the indirect installation.

Considering the unquestioned satisfactory and efficient illumination obtained, the solution of a problem which has heretofore presented great difficulties is indicated.

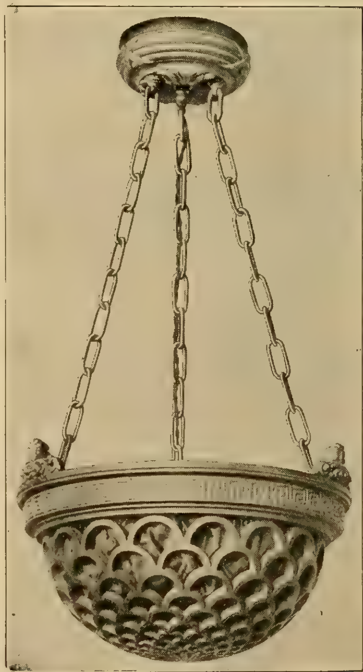


FIG. 4.—TYPE OF SMALL UNIT.

Fixtures and Accessories

A Study of Some Recent Models of Electroliers

It is a rather curious fact that the electric light, rightly claiming superiority by reason of convenience both in installation and use, has continued to pay homage to gas lighting by the undisguised use of gas piping to support the lamps. Such a condition was, of course, to be expected in the early stages of electric lighting, when the simplest way to install such lamps was to attach them to existing gas fixtures. But to the amateur of lighting fixtures the almost universal continuance of such a course seems unjustified. In substantiation of this opinion we may point, as we have frequently done before, to the prevailing practice in Europe, which long ago ceased its allegiance to this conventional construction.

It is an undisputed principle in the æsthetics of applied art that the general structure of the object must declare its reason for existence; there must be no trickery or unsolvable puzzle. An electric lamp, even with a comparatively large

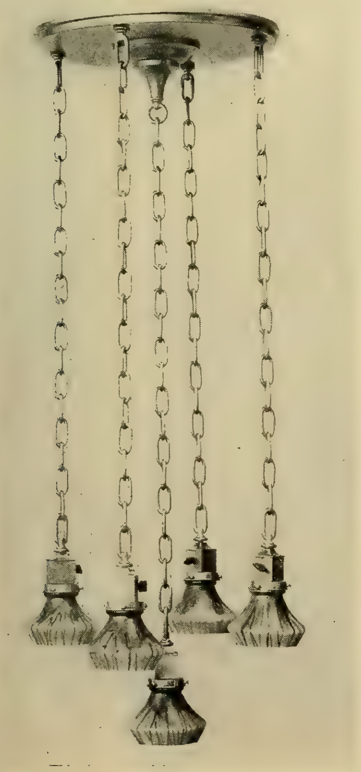


FIG. I.

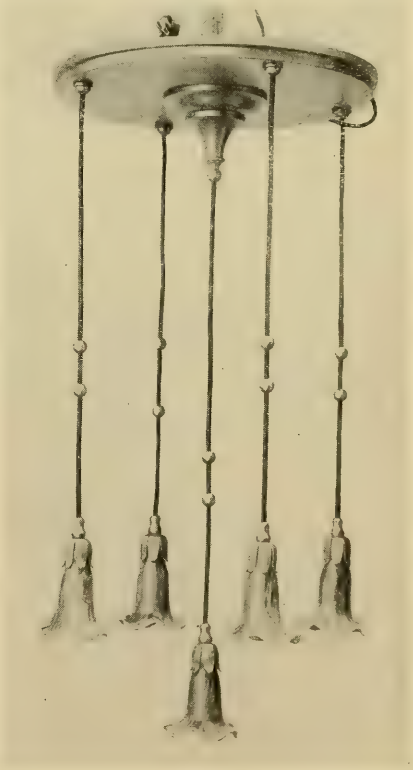


FIG. 2.

FIG. 3.

The two methods of flexible support for electric lamps are: Chain, and flexible conduits. Fig. 1 illustrates a use of the former of these and Fig. 2 of the latter. Both are exceptionally pleasing by reason of their frankly discarding all superfluous additions in the attempt to ornament. Everything is present which the circumstances require, and each part is in itself either distinctly decorative or is mechanically sufficient, the combination making up a very pleasant total result. But satisfactory as are these attempts, we venture the asertion that there is still something lacking. When an electric lamp is supported by a chain it must be supplied with current; therefore, the addition of flexible conduits. These are usually placed into the chains and made as inconspicuous as possible. Just here lies the single objection: they can never be wholly hidden, and if they were, would leave the lamps without any apparent source of current. There seems to be little choice between the two horns of the dilemma.

accessory in the way of globe or reflector, is of actually light weight, and therefore does not justify an unduly strong support. Furthermore, it is now so well known as to be unconsciously recognized that an electric lamp requires to have its communication with the source of supply by means of two insulated wires, which may be of very small diameter, and can be put into an almost perfectly flexible form when desired.

Rigidity, the necessity of the mechanical support of a gas lamp, with the limitations which it places upon artistic treatment, is therefore entirely absent in the case of the electric light. It is pleasing to note that there is at least a distinct tendency in this country to utilize these advantages of electricity in the construction of fixtures; in other words, there is a growing tendency to get away from the old central gas pipe and radiating arm structure which has so long thrust its monotony upon us.

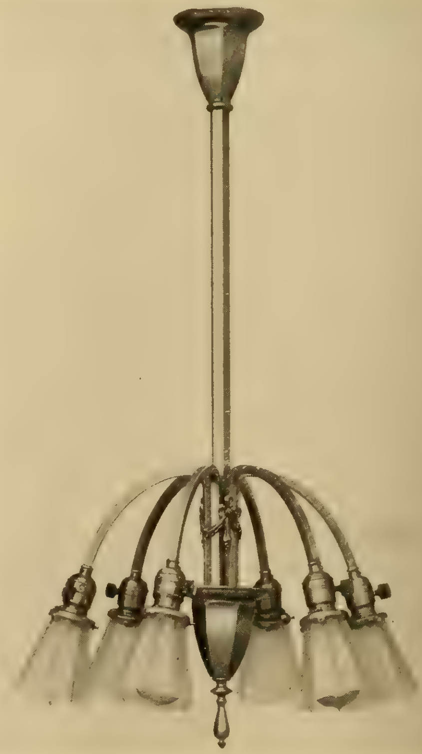


FIG. 4.

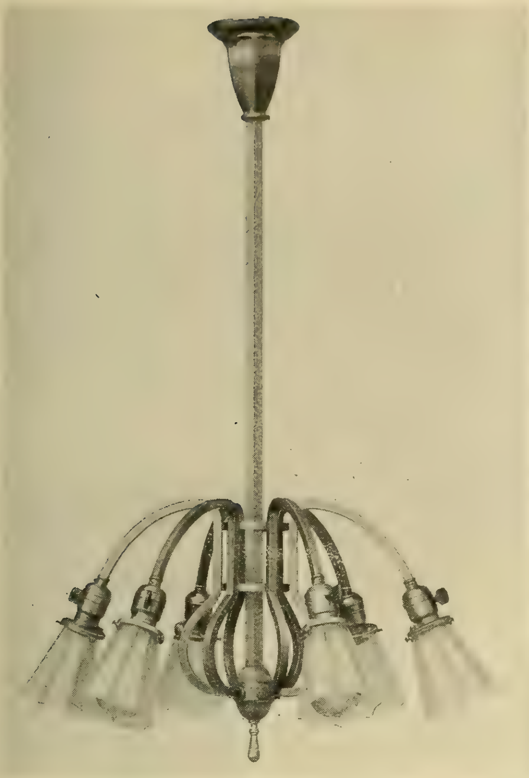


FIG. 5.

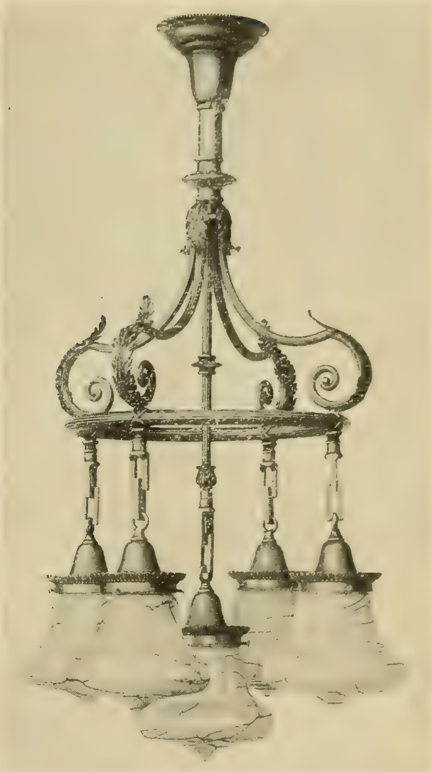


FIG. 6.

In some cases it might be better to frankly show the conduits. Thus, in Fig. 3 the conduit could be dropped in the axis of the electrolier between the chains. The use of flexible cord in this country has been retarded by the underwriters' rules. The regular two-strand conduit, overwound and worked into a single, smooth, semi-rigid tube, is almost as difficult to handle satisfactorily as a metal tube. We have repeatedly called attention to the graceful appearance and electric advantages of a flexible cord for such purposes made up of the two flexible conduits overwound to perhaps twice the diameter of the ordinary flexible cord, and twisted together with a flexible steel wire, the whole giving the appearance of a rope or drapery cord. The larger diameter is necessary in order to take away the flimsy and unsubstantial look of the ordinary cord.

With the commendable efforts to get away from the rigid suport it is likewise a pleasure to note the efforts, timid though some of them are, to introduce the Art Nouveau motifs. Fig. 3 shows a successful example of this kind. While the essential feature of this school is simplicity, analysis will show that it is not mechanical simplicity, but artistic simplicity. For example, in the fixture shown the supporting arms could scarcely be more simple, and yet observe that at every point the outline is of a different curvature, absolutely preventing its construction by the mere bending of a brass tube. The two supports carrying the chains are of the same order. The layman should understand that this fixture, though apparently simple, is several times as expensive to manufacture as one containing much alleged ornamentation. It is a good piece of art metal work, as well as a satisfactory lighting fixture; for this combination the layman should, and will when he understands the subject, be willing to pay a fair price.

Fig. 4 is a rather remarkable example

of what can be accomplished in decorative effect by the use of simple curves. The construction here is entirely mechanical, except the light casting about the tubes at the bottom. Harmony of all the parts, however, is such as to be decidedly pleasing. This construction, being mechanical, is therefore less expensive.

Fig. 5 is another example to which exactly the same remarks will apply.

Fig. 6 is a successful attempt to get away from the stereotyped central support while retaining the motifs of the French periods. The curves retain the spirit of the motif, and the decorations are very happily placed. The globes are evidently of a tinted opalescent glass, a feature to which the practical illuminating engineer may protest, but in reality a matter wholly for the choice of the user.

Figure 7 has several points of interest. First, there are the three links of chain forming part of the central support, which is sufficient to prevent the appearance of stiffness due to tube construction. Next, there is a slight deviation in the curves of the supporting arms from the mathematically severe circle. But the point most particularly to be observed is the method used to give the supporting arms and the lamps with their flowerlike shades and husks the natural appearance of springing from a source below. The motif in this fixture is essentially *art nouveau*—*i.e.,* it is a simulation of the natural lines of a growing plant, and hence the branches must spring from a support beneath. To show such a support and at the same time have the fixture mechanically supported from above is one of the most difficult problems with which the fixture designer using this school of art has to contend. The treatment here may be considered successful. The arms are given a considerable length of attachment to the main stem, and the bulbous finish at the lower end is sufficiently suggestive of the origin of a plant to meet the psychological requirements. The shades carry out the general motive admirably. In point of mere illuminating efficiency the fixture will probably rank low, mostly by reason of the lilylike shape of the colored opal shades used; but as a decorative fixture, in which efficiency is not of prime importance, it has much to recommend it. The single discordant element is the ceiling canopy, which has a suspicious look of having been adapted from a Colonial design.

From the examples given herewith and from others which have been previously shown in these columns it is clearly evident that a day of better artistic ideals and a greater tendency to original creation in fixture design is dawning. It is a time of great opportunities for development in this particular branch of artisanship. As the cheap chromo and the cabinet organ have been superseded by the photogravure and the piano, so the clumsy and awkward cast iron or spelter fixture, with its childish incongruities of ornamentation, is being replaced by a higher form of art metal and glass. While we may frankly admit that as yet we have not reached the general level of the European nations in this particular field of applied art, we may at least have the consolation of knowing that we are making progress; and it is not a hope born of mere patriotism.

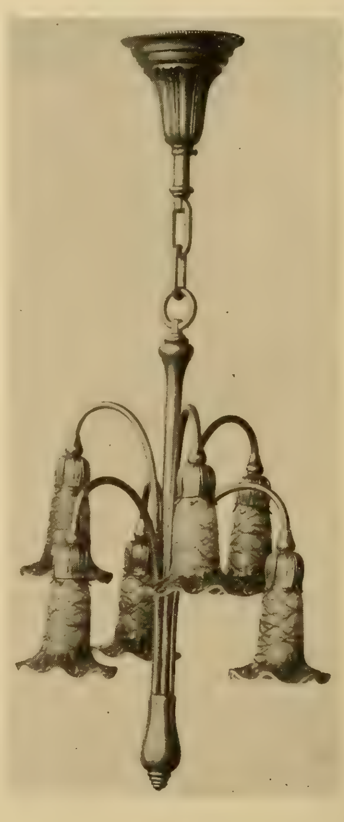


FIG. 7.

Theory and Technology

Simplification of the Fluxolite Paper

By Alfred A. Wohlauer.

In this year's April issue of the Illuminating Engineer the present writer described a device which had the object to enable the designing illuminating engineer to carry out numerous calculations without the complication of planimeter, slide rule, tables or tedious mathematical calculations or computations. This device, called the Fluxolite Paper, is illustrated in Fig. 1. It was expected that the practicing illuminating engineer would try the scheme out and criticise it according to his individual experience. Up to the present time, however, only Mr. J. S. Codman and Mr. T. W. Rolph took the trouble to do this, and it may be permitted to express the writer's gratitude on this occasion. The criticism of the above gen-

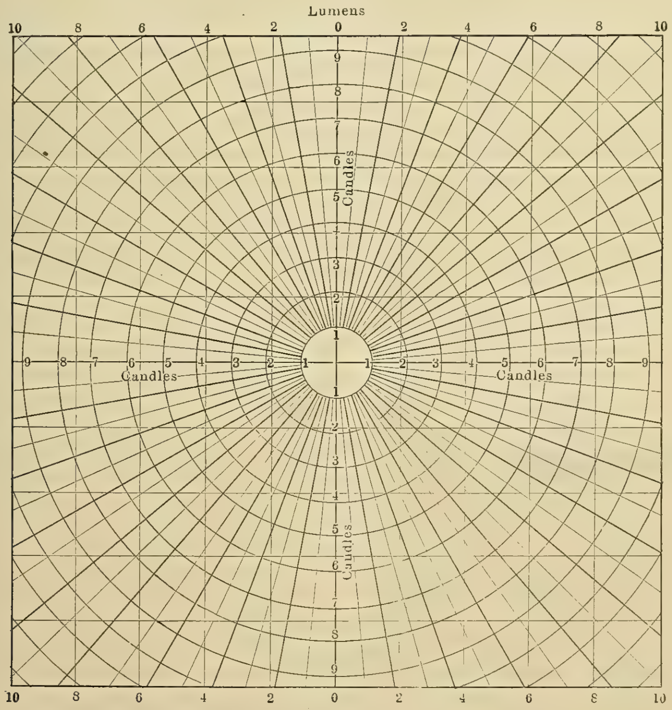


FIG. I.—FLUXOLITE PAPER.

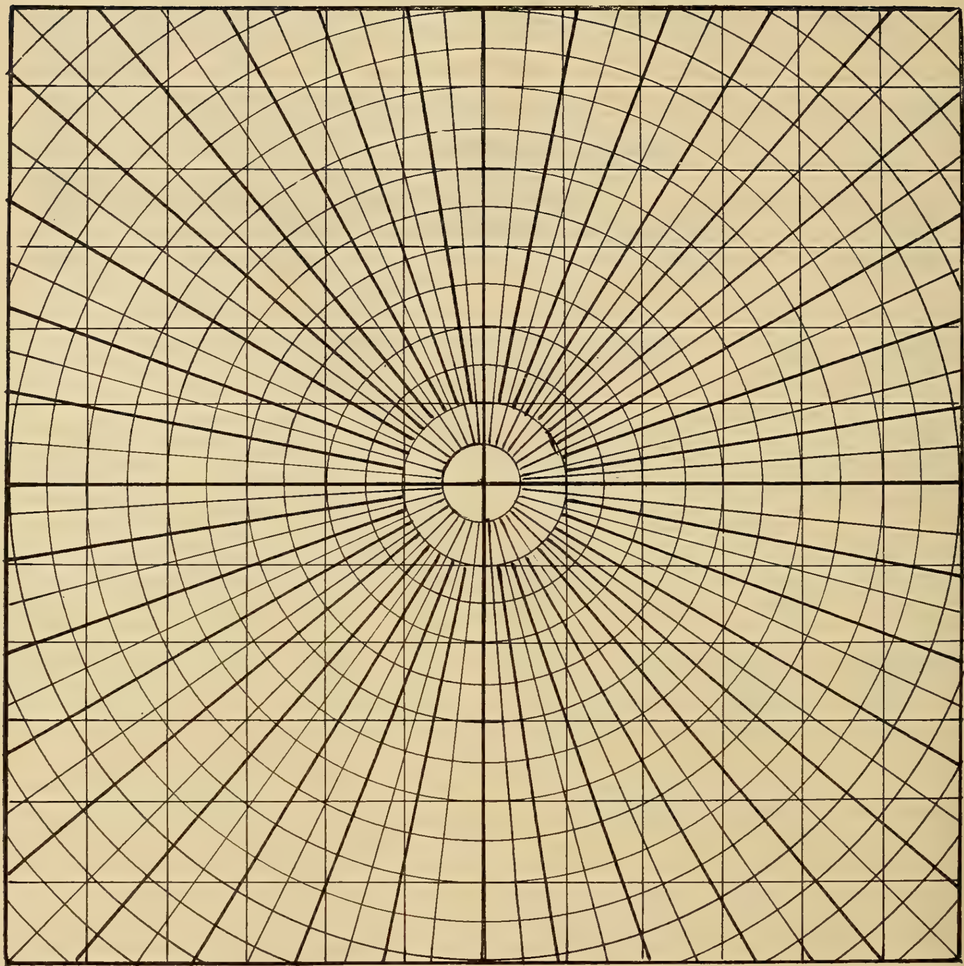


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FIG. 2.—NEW FORM OF FLUXOLITE PAPER.

tlemen tended to show that by the superposition of rectangular co-ordinates upon the usual polar co-ordinates, the working sheet is obscured to such an extent that its handy operation is more than permissibly impaired. A suggestion was offered to the effect as to omit the rectangular co-ordinates altogether and to measure the abscissæ of the various light vectors by a separate ruler, multiplying their values or the sum of their values by a certain constant. This method would be very convenient for anybody who is sufficiently familiar with the theory of the flux of light in order to be able most readily to compute the various quantities. It has, however, the drawback of an additional working tool, the ruler. Moreover, it requires two mathematical operations (multiplications) which are obviated by the use of the original form of fluxolite paper. The latter are the following: On the one hand one has to multiply the abscissæ with a constant, which is determined by the angular subdivision of the sphere; on the other hand, a factor has to be introduced with respect to the candle power scale of the polar diagram. Especially the latter multiplication arising from the necessity of varying the candle power scale, according to the size of the illuminant, should be avoided, as it is entirely arbitrary and cannot be subjected to

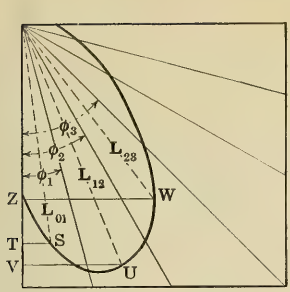

FIG. 3.

general rules. The other multiplication, however, would not constitue a drawback if the complication set forth thereby is compensated by an increased simplicity and by a broadened field of application.

These considerations have lead the writer to a modified and simpler form of the fluxolite paper, which is illustrated in Fig. 2. Here the rectangular co-ordinate system has the same scale as the polar candle power scale, and it can easily be recognized how much the clearness of the paper has been improved upon. Moreover, there is no multiplication required to take care of the variations of the candle power scale, for the lumen scale simultaneously follows any change of the candle power scale. However, the multiplication with a factor determined by the angular subdivision is not eliminated; but this can very well be put up with, as the general scope of the paper is enhanced and its use universalized. In order to understand this and in order to get a clear idea of the fundamentals on which these relations are based, it might be well to briefly dwell again on the theory involved therein.

It was stated in the article mentioned above and published in the April issue of this journal that the flux of light over a certain angle is equal

$$F_{12} = 2\,\pi\, L_{12} \times (\cos \phi_1 - \phi_2) \qquad (1)$$

(see Fig. 3).

It, furthermore, was demonstrated that

$$F_{12} = 4\,\pi \times L_{12} \sin \frac{\phi_1 + \phi_2}{2} \sin \frac{\phi}{2} \quad (2)$$

In this equation

$$L_{12} \times \sin \frac{\phi_1 + \phi_2}{2} = A$$

the abscissa of the light vector bisecting the angle for which the flux is to be measured.

It further may be mentioned in passing that the value

$$2 \times \sin \frac{\phi}{2} = S$$

represents the length of the chord (but not the arc), extending over the angle ϕ at the unit radial distance (*i. e.,* for the unit sphere).

The equation for the flux over the angle ϕ is, therefore, the following:

$$F\phi = S \times A \times 2\,\pi.$$

For equal angular subdivision this value S is a constant, and thus

$$F\phi = R \times A \qquad (4)$$

where $\quad R = 2\,\pi\, S.$

This factor R has been calculated and compiled in Table No. 1 for various angular subdivisons: it determines the scale of the rectangular co-ordinate system of the original fluxolite paper, while in the case of the new form of the fluxolite paper it represents the factor by which the abscissa of the sum of the abscissa has to be multiplied in order to obtain the corresponding flux.

Thus it can easily be recognized that the new form of fluxolite paper can be used generally for all kinds of angular subdivisions, and is not restricted exclusively to a single one. It is left that way to the judgment of the designing engineer what subdivision he prefers in a certain case. Of course, the accuracy of the result is affected thereby so that the smaller the angle of subdivision or the larger the number of subdivisions, the more exact the result; still up to a subdivision of

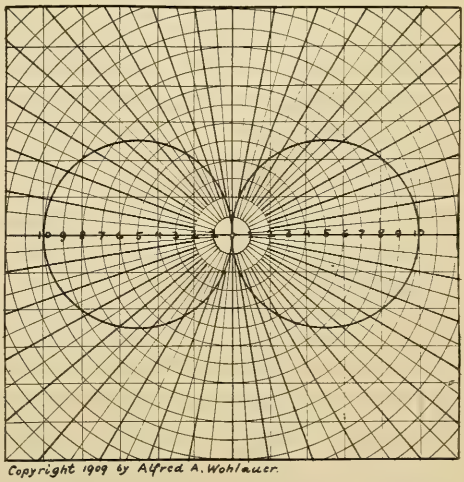

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FIG. 4.—APPLICATION OF FLUXOLITE PAPER.

30° the accuracy of the result is very fair.

All this is illustrated by a practical example, which at the same time explains the application of the new form of fluxolite paper: for the same polar diagram, Fig. 4, the total flux of the illuminant is determined, using different angular subdivisions. One proceeds in a similar way as in the case of the original fluxolite paper by reading the abscissæ of the light vectors bisecting the various angles under consideration and adding the various values together.

For an angular subdivision of 5° the sum has to be multiplied with R = .548, for 10° subdivision with R = 1.098, for 15° with 1.64, for 30° with 3.25. The results are compiled in Table No. 2.

Another advantage of the new form of the fluxolite paper is the following: In order to quickly determine the total flux of an illuminant one has a means to expedite the matter in cases where the light distribution of the lamp is rather uniform over a large angle. In such cases one does not need to adhere to the same angular subdivision over the total sphere nor take a correspondingly large number of readings, but one value over the angle of uniform light distribution is sufficient to obtain the correct value of the flux contained therein. One only has to read the value of the abscissæ of the light vector bisecting this angle of uniform intensity, multiplying its value with the constant corresponding to the angle under consideration. For instance, if the light distribution of a lamp is rather uniform over an angle from 15° to 45°, as illustrated in Fig. 5, the flux over this angle is equal the abscissa times the constant for 30°. Such a method will be even correct for an angular subdivision of 90°. In order to prove this one can use a light source of exactly uniform light distribution over the whole sphere as, for instance, a point source of light. In this case the value of the abscissa of 45° has only to be multiplied with 8.85 in order to arrive at the correct value of the total flux. Of course, in such a case it would be just as simple to multiply the light vector constant over the whole sphere with 4 π in order to arrive at the identical value. This is mentioned only in order to demonstrate the exactness of the method. For instance, if the uniform light intensity in all directions is 10, then the hemispherical flux is 7.07 x 8.85 = 62.8 = 10 x 2 π.

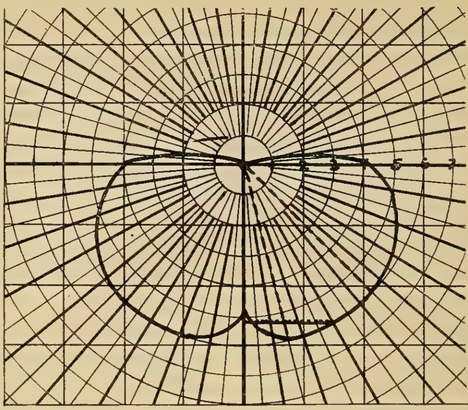


FIG. 5.—FLUX BETWEEN 15° AND 45° F. = 30 x 3.25 = 97.5.

In order to derive the mean spherical or mean hemispherical candle power from the flux readings, one usually has to divide the sum of the flux components by 2 π or 4 π in a similar way, as was suggested in the case of the original fluxolite paper. One also can proceed multiplying the various abscissæ with S, the length of the chord of the angular subdivision and their sum would constitute the mean hemispherical or mean spherical candle power as easily to be derived. It must be remembered, however, that the value of these components (the product of the abscissa times the chord) does not determine the mean zonolar candle power over a certain angle, but only a certain fraction thereof, the size of which varies according to the number of angular subdivisions; still, it is interesting to know that the mean spherical or hemispherical candle power can be directly determined from the new form of the fluxolite paper if instead of the constant R of the third column of Table I, another constant (second column of Table I), is used, the value of which is equal to the chord of the angular subdivision.

Incidentally, it may be mentioned that the equation for the mean zonolar candle power is

$$L_2 = A\ S\ n \qquad (5)$$

where n = the number of angular sub-

divisons from 0 to 90°. Their mean value $\frac{\Sigma L_2}{n} = \Sigma A S$, gives the spherical candle power.

Summing up, it has been demonstrated that the new form of the fluxolite paper combines a number of advantages over the original form, as it is more perspicuous and its use universalized. It can be adapted to all kinds of angular subdivisions, and even the determination of the mean spherical candle power is equally simple. Still, it must be remembered that the original form of the fluxolite paper has the great advantage that no multiplication; in fact, no calculations, are required for the determination of the flux, and errors as to candle power and lumen scale are practically avoided. On the other hand, the new form of the fluxolite paper will appear preferable to the illuminating engineer who has become familiar with its idea and fundamentals, so that an intelligent use of the various constants is assured.

TABLE I.—CONSTANTS FOR FLUXOLITE PAPER.

ϕ	S = 2 sin ϕ 2.	R = 4 sin ϕ 2.
5	.0872	.548
10	.1743	1.098
15	.2611	1.64
20	.3473	2.18
25	.4329	2.72
30	.5176	3.25
35	.6014	3.77
40	.6840	4.3
45	.7654	4.8
50	.8452	5.3
55	.9235	5.8
60	1.000	6.28
65	1.0746	6.75
70	1.1472	7.2
75	1.2175	7.65
80	1.2856	8.1
85	1.3512	8.5
90	1.4142	8.85

TABLE II.

	Subdivisions.				
	5°	10°	15°	30°	90°
5	.05	..	..	..	..
10	.2	1	.2	..	..
15	.6	..	..	..	..
20	1.0	.7	..	.7	..
25	1.6	..	1.6	..	..
30	2.2	1.9	..	..	.
35	2.9	..	..	..	..
40	3.7	3.4	3.7	..	..
45	4.5	..	..	..	.
50	5.4	5.0	..	5.0	5.0
55	6.3	..	6.3	..	..
60	7.1	6.7	..	..	..
65	7.9	..	..	..	..
70	8.6	8.3	8.6	..	..
75	9.2	..	..	..	.
80	9.6	9.4	..	9.4	..
85	9.8	..	9.8	..	..
90	9.95	9.9	..	..	..
Sum	90.6	45.3	30.2	15.1	5
2 × sum	181.2	90.6	60.4	30.2	10
Flux	99	99	99	98	89
M. S. C. P.	7.85	7.85	7.85	7.8	7.1

The Power of Plaster to Absorb Sulphur from Illuminating Gas

Mr. Arthur D. Little, chemical expert and engineer, Boston, recently undertook to determine whether plaster serves to absorb sulphur gases from the air and thus reduce the amount of sulphur below that which would naturally be expected in the room where gas is burned. The experiments were conducted in the room of an ordinary house having a contents of 615 cubic feet. The ceiling upon which investigations were made consisted of exposed calcimined plaster. With extensive chemical equipment and a fan for regulating the ventilation, it was possible to determine the manner of disappearance of the sulphur gases in the room. The gas was continuously burned and the rate of absorption by the plaster was carefully determined. When the ventilation was greatly reduced it was found that the increase in the sulphur gases was not at all in proportion to what might have been expected. This was shown to be due to the fact that some of the sulphur was absorbed by the plaster. To such an extent was this the case that in one instance only about one-third of the expected amount was found in the air. When an excess of sulphur was discharged into the air the expected amount dropped to less than 10 per cent.

Analysis of the plaster of the experimental room at the beginning and during the experiments showed that there had been an actual increase in the sulphur which it contained, due to the absorption of sulphur gases from the air. In a word, the plaster had served as a medium by which sulphur was removed from the air. But it was shown that perhaps not all of the sulphur over and above that which disappears by the changing air is removed by the plaster, for a considerable portion of it may be removed with the water that condenses upon cold surfaces, particularly the walls.

Mr. Little, however, made the interesting calculation that the plaster of a ceiling would serve to absorb sulphur gases from ordinary gas burning 25 feet per day during the probable existence of a house.

The Third Annual Convention of the Illuminating Engineering Society

It would perhaps be more fitting for one to write of the convention who had not been so intimately connected with its arrangement; but there is an old adage that says something about "telling the truth, and shaming the family," that may be invoked to cover the idiosyncracy.

In some ways the convention was a pronounced success; in others it was disappointing. The program of papers was excellent, and would be a credit to any scientific association. The authors included some of the highest authorities on the various phases of the science, and the subject matter was largely original and therefore a valuable addition to the literature of the profession. The discussions were spirited and contributed by those eminently qualified to speak. Interest in both papers and discussions was genuine, and showed a degree of earnestness that gives assurance of permanency and progress to the society. There was almost no evidence of mere formality and perfunctory discussion during the sessions. Those spoke who had something to say, and who were eager listeners to the others.

The entertainment program was exceptionally good. This opened with a musicale and reception on Monday evening, at which the following program was presented:

Miss Alice Genevieve Smith...........Harpiste

FESTIVAL QUARTET.

Mrs. Frances Hewitt Bowne...........Soprano
Miss Rose Bryant...................Contralto
Mr. John Young.......................Tenor
Mr. Bertram Schwahn..................Basso
Assisted by
Miss Helen Wolverton, Accompaniste.

HOLLAND TRIO.

Nol. Cornelissen......................Pianiste
Andries Cornelissen...................'Cello
Gan Geerts............................Violin
DIRECTION OF WALTER R. ANDERSON.

PROGRAM.

1. Quartet, (a) "Come All Ye Lads and Lassies"...............H. Lane Wilson
   Quartet, (b) "Rosary"............Nevin
2. Harp, "Dance de Sylph".........Godefroid
3. Bass Solo, Prologue from "I'Pagliacci," Leoncavallo
4. Trio, "Extase"..................Ganne
5. Soprano Solo, "When Into Thine Eyes I Gaze"....................Shattuck
6. Quartet, "Rigoletto"................Verdi

PART TWO.

1. Trio, (a) "Traumerei"..........Schumann
   Trio, (b) "Minuet"...........Paderewski
2. Tenor Solo, "The Message"....Blumenthal
3. Harp, "Impromptu Caprice"......La Vana
4. Contralto Solo, "Spirit Flower," Campbell-Tipton
5. Trio, Selection from "Samson and Delilah"...................Saint Säens
6. Quartet, "Carmina Waltz".........Wilson

MUSICAL PROGRAM DURING RECEPTION

Following Musicale.
Main Hall................First Floor
Cavalleria Rusticana (Selections)......Mascagni
Rose Mousse..........................Bosc
Serenade ....Schubert
Estudiantina ....Lacome
Spring Song.....................Mendelssohn
Tannhäuser (Selections)...............Wagner
Dollar Princess........................Fall

The large number of local members who failed to attend missed a rare treat indeed. Every number was of a high order of merit, and received most enthusiastic applause from the small audience present. The harpiste, Miss Alice Genevieve Smith, of Chicago, held her hearers literally in breathless admiration. Miss Smith is well known in Western musical circles, being unquestionably the finest lady harpiste in that section, and was brought to New York by the Entertainment Committee especially for this occasion. She is a musician of rare natural talent and possessed with a perfection of technique that is seldom reached.

The automobile trip given to the visiting ladies on Wednesday was especially enjoyable by reason of the perfect autumn weather. The itinerary had been carefully planned, and each guest was presented with a neatly printed copy, which served as a guide.

Wednesday evening a reception was tendered the society by the Holophane Company, in the rooms of the Machinery Club, on the top floor of the Hudson Terminal Building in lower New York. This closing festivity was proportionally well attended. A magnificent view of all lower New York is obtainable from the windows of the club rooms; and music, dancing and refreshments completed the enjoyment of the evening.

The exhibition held in connection with the convention was interesting and highly creditable to the exhibitors, but in common with the social features was comparatively little patronized.

In general, the program both for the regular proceedings and for social enjoyment, as well as the exhibiton, were planned on a generous scale and carried out with an exceptional completeness of detail, for which credit is justly due to the chairmen of the several committees. Special mention should be made of the work of the Entertainment Committee, of which Mr. Albert J. Marshall was the chairman, and who was largely responsible for the faultless arrangement and execution of this part of the program.

Briefly, there was but one thing lacking to have made the convention the full success which was hoped for and anticipated, and that was attendance. Following the custom of previous years the convention was planned and carried out by the local section. In a general sense, therefore, all members of other sections were guests of the New York section; and it was the members of this section that were most conspicuous by their absence, thereby placing the section in the awkward position of the host who invites people to his home and then is absent when the guests arrive.

The first day's registration showed only 100 members and 45 guests present, a poor showing when it is considered that the New York Section alone contains 350 members. The total registration was 454 —259 members and 195 guests—practically one-fourth of the total membership.

Speculation as to the cause of this condition of affairs, though of no great value, may be of some interest. In the first place, all organizations of this kind contain three classes of members: First, those who simply wish to have their names connected with the organization for the purpose of either helping themselves or the society by being identified with its work; second, those who have the first object in view, and beside this desire to have the proceedings for the practical information which they may contain; and, third, those who take an active personal interest in the management and progress of the society and attend meetings whenever possible for the direct good which they can get out of them. Of these three classes, the first largely outnumbers the other two, and the existence and work of a society must always depend upon the small minority making up the last class. In these respects the Illuminating Engineering Society is neither better nor worse than other similar organizations. The real vitality of such a society is shown, not by the size of its membership roll, but by the interest taken, and the harmony shown among the comparatively small number who do the work. In this respect the Illuminating Engineering Society must certainly be considered as a very live organization.

After election the defeated party always finds plenty of sufficient excuses for its defeat, all of which may be summed up in the laconic remark, that " their candidates did not get enough votes." Seeking reasons why there was not a larger attendance, especially of local members, is a somewhat similar task. The Hudson-Fulton celebration was undoubtedly largely responsible. All New Yorkers were busy with personal entertainment, and doing double duty in taking care of their own private affairs. Furthermore, it is past the season of vacations; and with the complete revival of prosperity which is now upon us every one is back in harness and working overtime in preparing for and taking care of the business in hand. It was probably not the best time to hold the convention for these reasons. On the other hand, it was considered that the attractions of the Hudson-Fulton celebration and the low transportation rates

which were sure to be made would enable many from other sections to visit the convention who would not otherwise be able to do so. Whether this overbalanced the other handicap each must decide for himself.

If the exact truth were known, it would probably disclose the fact that the influx of outsiders to witness the Hudson-Fulton festivities was very far below what the daily press of the city would like to have people believe. To be sure, the line of march of the parades was crowded with spectators; but the inhabitants of Manhattan Island alone would be quite capable of doing this. The best evidence in such cases is the condition of hotel accommodations, and these did not show any indications of enormous overcrowding. If this is a fact it can probably be attributed to the causes already mentioned—namely, that the people of other sections of the country are too busy with catching up in their business for the slack times of the past two years.

Again, New York is a poor convention city. There are too many attractions and distractions, and the task of affording entertainment that will compete with what is offered in unbounded measure by the innumerable playhouses and resorts of the city is simply insuperable. In the large majority of cities the program provided by the society would have been an event to be anticipated and remembered; in New York it was as a leaf in the forest. Probably the best solution of the problem would be to hold the convention in the most unheard of place that had reasonable railroad communication, and for the entertainment features to consist of events that were as far as possible removed from the stereotyped program of city enjoyments. With all its opera houses, theaters and spectacular restaurants, you can get neither a clam-bake, nor a straw-ride, nor a corn-roasting in New York City; and there are doubtless many members of the society whose musical and other accomplishments would give the heartiest kind of pleasure.

All things considered, it is impossible to look upon the convention in any other way than as a success in the best sense of that term. Good papers, valuable discussions and lively interest by those present were evidence of this.

The Detroit Meeting of the American Gas Institute

This meeting was held October 20, 21 and 22. The features which most concern illuminating engineers were a lecture by Dr. E. P. Hyde on "Illuminating Engineering" and a paper on "Illuminating Engineering in Its Practical Applications," by Mr. Norman Macbeth. A review of these papers will be given in our next issue.

An attractive social entertainment program was provided.

Some two years ago we took the gas interests severely to task for their neglect in recognizing the importance of this new profession and science to their business. The indictment caused a considerable discussion on both sides of the Atlantic, and we believe it is not too much to say it has been instrumental to a considerable degree in bringing about a very decided change of front since that time. Every important gas convention held since has discussed the subject, and progress has been very rapid. At the next election of officers of the Illuminating Engineering Society thereafter, Mr. W. H. Gartley, of the United Gas Improvement Company—who, by the way, made a spirited reply to our charges—was elected president, and during his administration thus far there has been a very notable addition of members representing the gas interests.

Another evidence worth mentioning is the establishing of an Illuminating Engineering Laboratory by the Welsbach Company, with Mr. Norman Macbeth in charge. It is doubtful if there is a man in the profession of more varied experience and, therefore, of more unbiased judgment than Mr. Macbeth. His practical and theoretical knowledge of the subject may be judged from the fact that he was the first of the profession to obtain from it alone a comfortable income.

Perhaps the most important feature of all in the program outlined for the Detroit meeting is the lecture by Dr. Hyde. The significance of this lecture does not consist in the fact that Dr. Hyde will lecture on this subject, for surely no one is more competent, but that he should lecture before a Gas Association. Dr. Hyde is in charge of the laboratories of the National Electric Lamp Association, a re-

markable institution, of which we shall give a full account in a subsequent issue. We particularly commend this feature to the consideration of our confréres in England. The great objection there urged to the establishment of illuminating engineering was that it would be impossible to conciliate the bitter hostility between gas and electricity. On the other hand, this was urged, and very rightly, as the most potent reason for the formation of such a profession and society. The society has been formed, however, and our more conservative brethren will unquestionably in time see the wisdom of the American policy of conserving every energy for positive and aggressive work along our particular line, instead of dissipating it in useless fanfaronade upon competitors.

Our criticisms of two years ago have ceased to apply, and the gas interests today are doing their full share in promoting the cause of illuminating engineering, to their own and the public's benefit.

Illuminating Engineering and the Fixture Trade

The fixture trade as a whole has been slow to appreciate the significance of illuminating engineering. This may be accounted for in several ways. In the first place illuminating engineers have been rather outspoken in their criticisms of prevailing fixture design, generally for the reason that such designs interfere with the most efficient illuminating results, and are more elaborate than necessary. From this the trade took fright, fearing that should these criticisms prevail there would be a very considerable curtailment in the gross receipts of the business.

In the second place the illuminating engineer frequently included more or less complete fixture specifications in his plans, which created a certain feeling of resentment on the part of the fixture manufacturer, who considered that his long familiarity with the business placed him above dictation from what he considered a mere "upstart."

Third, a large amount of the tangible assets of the manufacturer consists of special tools and machinery for turning out stock designs, and any radical change in either the artistic or constructional features would make junk of this equipment.

The wisest course, however, is to expend as little energy as possible in railing at what one thinks is wrong, and to investigate all innovations which tend to bring about permanent changes as carefully and as promptly as possible, in order to accommodate one's self to new conditions as they arise, and make them a source of profit instead of a loss.

There is no longer a shadow of doubt that the work of illuminating engineering is going to proceed at a fairly rapid pace. Illuminating engineering, in a word, stands for better practice in artificial lighting, and it requires no great genius to perceive that the old methods are sufficiently poor to permit of great changes for the better. This means that at least 90 per cent. of the present lighting installations will be remodeled within a reasonable length of time. Consider what all this remodeling is going to mean to the fixture trade. Ordinarily, the sale of fixtures belongs to that class of trade in which there are no repeat orders or renewals. A house or building equipped with fixtures once is equipped for at least that generation; so that the manufacturer's business has been determined by the number of new installations contracted for. But illuminating engineering is not only making this regular field more careful and appreciative in its purchasing power, but is clearing the old land in preparation for a new crop. In reality, therefore, there is no line of trade which will so directly and largely benefit, financially, from the spread of illuminating engineering as the fixture trade. Of all the trades and professions it should, therefore, most heartily and vigorously promote the cause of illuminating engineering.

The New York Electrical Show

The New York Electrical Show is an annual event of great interest to the public. as well as to the electrical industries. From all indications the present show has considerably surpassed all previous efforts in general public interest, as evidenced by the daily attendance. As a matter of course, illumination forms the most spectacular part of such a show. The public have become sufficiently familiar with the

new electric lamps, both arc and incandescent, to have lost the spirit of curiosity in regard to them. But the possibilities of light as a special attraction will never diminish. Undoubtedly this year's show was the most attractive in all its decorative features of any that has been given. The entire auditorium of the enormous Madison Square Garden was decorated with white and yellow bunting, completely concealing the unsightly roof and side walls. The lighting, while brilliant, was not overdone, and presented an effect that was simple, beautiful and restful, rather than garish and spectacular, a too frequent result in such cases. The effect was distinctly "pretty." The uniform construction and decoration of the numerous booths also added greatly to the total effect.

The exhibits are well diversified and of such a nature as to attract popular attention. While nothing startlingly new was shown, there were a sufficient number of devices that was either new to the public or of such ingenuity as to furnish a large fund of general interest and even amusement. "We are all children of a larger growth," and we never quite get over wanting to "see the wheels go wound." By far the most taking feature of a magician's exhibiton is the explanation of how the trick was done. Electricity is still enshrouded in much mystery to the ordinary observer, and to be shown how the thing works appeals to that inborn curiosity which is never quite drilled out of us by the routine of life. Wherever there was machinery in motion there the largest crowds gathered, and those who want to see if they used their eyes intelligently must have come away with no small number of practical ideas for utilizing this most protean of natural forces in the affairs of everyday life. The local lighting companies were naturally well represented beside the usual collection of of electrical novelties and devices for popular use. There can be but one opinion as to the general character of the show—it was a decided success.

Notes and Comments

Street Lighting Arches Ruled Out in Worcester Mass.

CITY'S LOCAL ADVISER DECIDES THEY ARE CONTRARY TO CITY LAW.

The Worcester Board of Trade has been moving toward a system of spectacular street lighting, and was apparently much taken with the arch idea. Fortunately, this system has been ruled out for legal reasons. We say "fortunately" because there are other systems that are less giddy and far more decorative than the arch system. The *Gazette* says:

> The system as proposed by the committee was that arches be stretched across the street and be securely fastened on the buildings. From these arches it was suggested that electric lamps be suspended. The system as suggested is similar to the one already established in Grand Rapids, Mich. The committee also presented plans relative to where the lights would be of the most value. It was found that the proposed system conflicts with the ordinances and the committee will now endeavor to obtain information as to some suitable system not in conflict.

Prizes for Decorative Lighting

ALBERQUERQUE, NEW MEXICO, OFFERS SUBSTANTIAL REWARDS FOR BEST DISPLAYS.

Argument as to the value of decorative lighting in increasing the trade and prosperity of a city has long since ceased to be necessary—everybody admits it. The stimulation of interest in the matter of offering prizes is certainly as yet an unusual, though undoubtedly commendable, practice. As an example of this form of public spirit, the far Western city of Alberquerque, New Mexico, comes to the front. The *Journal* has the following statement:

> Electricity has come more and more into use here with each succeeding fair, for decorative purposes, and the prizes offered by the fair association this year for the best decorated fronts have aroused keen interest in the decorative work. The first prize is \$100, the second \$50 and the third \$25, and even the third prize will go a long way toward paying the expense of a very elaborate decorative scheme. Several of the

business houses are planning elaborate decorations, while a number of very original schemes are being worked out.

Lincoln, Neb., Wants Better Lamp-Posts

MAYOR TAKES A TRIP AND COMES BACK WITH HIGHER IDEALS.

We recently called attention to the unsuitableness of wood as a material for modern lamp-post construction. The wooden pole is a relic of pioneer days, and has little excuse for being in this age of steel. Mayor Love, of Lincoln, Neb., has officially recognized this fact in the following recommendation to the City Council:

Gentlemen: I wish to suggest to your honorable body that we make some attempt to remove wooden poles which now disfigure our streets. These should be of iron of some ornamental design and could be utilized for lighting as well as for trolley purposes. A cluster of lights every hundred feet on each side of the street distribute the light much more evenly and effectively than an arc light at the intersection.

Norfolk, Va., to Have Another "White Way"

MERCHANTS SUBSCRIBE TO PLACE ARCHES OVER CHURCH STREET.

The contagious nature of spectacular street lighting is well shown in the staid old town of Norfolk. Main and Granby streets having been made "white," the business men of Church street immediately began to look to their laurels. The result is thus described in the *Despatch*:

The Church Street White Way Corporation has decided to enlarge its project for the illumination of that street by increasing the number of arches from 15 to 20, so as to have them not more than 100 ft. apart. The above project only includes that portion of the street from Main street to Charlotte street. That part between Charlotte and Queen street is being worked as a somewhat separate proposition, the number of the arches to be put on that part of the street to depend on the amount of money that can be raised from the merchants of that section, it being possible that the arches between those two points of the street may be 200 ft. apart.

Rochester, N. Y., Will Be Gorgeously Lighted During Its Coming Industrial Exhibition

LOCAL LIGHTING COMPANY, MERCHANTS AND CITIZENS JOIN TO MAKE THE ILLUMINATION MEMORABLE.

The city of Rochester has always been a source of pride to the great Empire State. Formerly the "Flour City," it later became the "Flower City," rightly socalld by reason of its extensive nurseries and seed farms. Its cleanliness, thrift and general beauty are recognized throughout the country. It was one of the first cities to use decorative posts supporting two arc lamps each for regular street illumination. What it proposes to do for its coming exhibition is thus set forth in the *Democrat and Chronicle*:

There will be light, in the broadest acceptation of the term, in the principal streets of Rochester during the coming Industrial Exposition at Convention Hall. Not only has the Rochester Railway and Light Company volunteered to supply electric current for the exposition proper, Vice-President and General Manager R. M. Searle has offered to furnish lamps and current for 7500 additional lights to be used in a unique scheme of street illumination during the week of the exposition.

It is proposed to erect six immense electric umbrellas, to be suspended at the intersection of the principal streets, and these lamps will be lighted each evening of the exposition, the current remaining on until one o'clock each morning. Appropriations in aid of this brilliant and attractive scheme and other fair features have been made by both the Common Council and the Chamber of Commerce. It is desirable that the generosity of Mr. Searle's company, which will in any event care for the largest item of cost, should be seconded by liberal contributions by public spirited citizens.

Light Committee Assumes the Role of Photometrists

GETS OUT ON STREET AND MEASURES UP ILLUMINATION.

Whether the "old" or "new" arc lamp is the best for street lighting was put to a practical test in Woonsocket, R. I., by the Committee on Street Lighting. The new arc is the titanium carbide lamp. The committee, in connection with the officials of the local lighting company, have recently made a test of the illumination of the two systems by the use of the "luminometer," evidently the Ryan instrument, depending upon ability to read print by the light under test. To make quite sure of impartiality a police officer and two chance passersby were called into service in making the tests. The following figures are interesting, as showing the

degree of accuracy of such an instrument in the hands of absolute novices:

Point of Equal Illumination—
Distance in Feet from Lamps.

Old.	New.	Observer.
137	118	Rhodes.
146	134	
193	229	Rickard.
218	215	
137	133	Cornell.
138	190	
191	180	Dulude.
210	196	
170	190	Nickerson.
167	170	Passerby.
115	127	Police Officer.
200	200	Passerby.

Totals—Old, 2022; new, 2082. Average—Old, 168; new, 174. 3.6 per cent. increase of distance due to new lamp.

It will be seen that eight of the comparative readings were taken by city officials, one by a representative of the company, and three by passersby, who certainly were unprejudiced.

The results bear out the statements of the company, its officials state, that the new lamp gives more illumination than the old one.

Franklin, Mass., Citizens Want Better Street Lighting, and Want It Quick

DO NOT WANT TO WAIT UNTIL SPRING FOR THE REGULAR ELECTION.

The situation is set forth as follows by the Woonsocket *Call:*

The subject of changing from arc lights to incandescents has for the past three or four days been, and is still, a topic for much discussion among citizens in every part of the town. The opinion seems to be unanimous that the town is not sufficiently lighted, and there appears to be a large majority who believe that a change to incandescent lights would make a decided improvement over the present lighting conditions. The opinion seems general, too, that the voters should not wait until April next to vote for the change, but should have the selectmen call a special meeting at once in order that the change can be made immediately and the people be given better lighting service during the winter. "Do it now" is the motto of those who advocate the change.

The dark nights during the past week, when the moon schedule was on, yet the moon was not in sight, had a good deal to do with the present agitation, although the town improvement committee of the Franklin Business Association can be given credit for starting the ball rolling.

Here and There

Despairing of being able to convince City Councils that Edgmont avenue is usually in inky darkness, merchants along that thoroughfare have started a movement to have erected at their own expense nine flaming arc lights between Sixth and Ninth streets. —*Philadelphia Inquirer.*

It is expected the city will be authorized to extend the illumination along Ocean avenue (Long Beach) at least two miles further, and add more lights to the pier and American avenue. This programme will give the city further material for the future advertising that the realty board intends carrying out.—*San José (Cal.) Herald.*

Mayor Reyburn has given his approval to a plan for lighting Independence Hall and Square. This plan calls for the erection of ornamental poles, on which arc lights will be strung about the block bounded by Chestnut, Walnut, Fifth and Sixth streets. It is expected the lights will be in place before Christmas.—*Philadelphia North American.*

All the open flame gas burners used for street lighting purposes in the city of Minneapolis will be replaced by incandescent gasoline lights, according to the decision of the Gas Committee of the City Council yesterday. Recently all of the incandescent gasoline lights were replaced by up-to-date gas burners and the gasoline lights have been in storage.—*Minneapolis Tribune.*

Property owners along Sixth street are now discussing illumination of that thoroughfare, after the general manner of lighting adopted on Washington and Seventh streets. The plan is to place 10 clusters to the block between Jefferson street and the Union Station, thus presenting a brilliantly lighted thoroughfare to travelers reaching the city at night. The subject is being canvassed, with the selection of electricity or gas, and also the number of lights that shall be placed on each post, matters for future consideration. The electric company and the gas company are competing warmly for the new street lighting contracts as entered into by property owners.—*Portland (Ore.) Oregonian.*

Correspondence

Electric Illumination Topics in Great Britain

By James A. Seager.

Special Correspondent.

Perhaps nothing is so vividly illustrative of the vast ineconomy of the carbon incandescent lamp than the practically stagnant condition which is at present existing among some of the power plant manufacturers in this country. Makers of turbines, engines and dynamos for electric power houses have within the last year or two experienced a severe setback in their output of plant, and this has been felt by one or two firms in an especially serious manner. The cause of this is ascribed to nothing more or less than the metal filament lamp, and electrical manufacturers, in the lean years which must intervene before the increasing popularity of electric light due to its further economy has necessitated extensions of generating plant, are turning their attention to other fields, such as power supply in collieries and other places. This expansion of interest may therefore be ranked as one of the beneficial side-issues of efficient electric lighting.

In this connection it is interesting to note the attitude of the engineers interested in the supply side of electric lighting to the new mode of illumination, and this can best be illustrated by a valuable circular letter which has recently been sent out by H. Faraday Proctor, M. I. C. E., M. I. E. E., the City electrical Engineer of Bristol. This reads as follows, and admirably epitomizes the situation:

"SAVING EFFECTED BY METALLIC FILAMENT LAMPS.

"With further reference to the above, I think it will probably interest you to know that in actual practice, consumers who have adopted this type of lamp effected an average saving of 50 per cent.

"As such reductions must obviously enormously decrease our revenue, advertising this lamp would at first appear to our disadvantage; on the contrary, I am convinced that consumers who are combining with such economy the benefits as regards health, convenience and immunity from damage to decorations and stock, will doubtless convince other householders interested, that electricity, far from being a luxury only, is an economical necessity, and hence we, as well as our consumers, will eventually benefit by this invention."

In a previous letter I incidentally mentioned that English makers of lamp clusters for street lighting had found that in order to maintain the life and brilliance of the lamps it was necessary to provide the enclosing globes with adequate ventilation. The importance of this precaution is brought to light by a correspondence which has recently appeared in *The Electrical Review*. A contributor stationed in one of the electric power houses in Great Britain discovered that certain lamps enclosed in practically air-tight well-glasses, and used to illuminate the cranks and connecting rods of some engines, continually failed. The glass of the bulb was evidently softened and a dint was formed. The vacuum disappeared and the filament, although it appeared complete, was probably burned completely through at one point. In reply to this communication another correspondent explained that the dinting of the bulb is caused by burning lamps in confined spaces so that when they are lighted the temperature rises sufficiently to bring the thin glass of the bulb to a soft state, allowing the atmospheric pressure to dint the glass. The filament was thus touched by the glass, which had a hole burned in it, thus

losing the vacuum and causing a deposit of soot. The excess of current flowing on the introduction of air caused a fusing of the connection of the lamp to the bayonet top before the filament burned through. Proximity to the engine, where the air was hot, facilitated the softening of the glass.

This correspondent states that he has found that ordinary 50 candlepower filament lamps employed for street lighting purposes and enclosed in 7-in. spherical globes, after burning a month or so, become hot enough to allow the atmospheric pressure to press in the glass bulb in a similar manner. Incidentally, he brings to light another curious phenomenon. He has found osram lamps, burned in the same kind of globes, the neck of which just allows them to pass in, became enlarged so that on burning out they cannot be extracted from the globe without breaking either the lamp or the globe. No explanation of this curious result is offered, but the writer states that he has experienced this no less than four times.

It is possible that esthetic taste is not too strongly developed in the electrical engineer, and a writer in *The Builder,* of London, has been falling foul of many of the arc lamp-post designs which endeavor to combine utility with beauty in this country. Incidentally the remark may perhaps be permitted that in London, however, a high factor of safety and high tensile resistance appear to be the attributes of highest value, in view of the vagaries of some of the petrol-driven omnibuses, which have violent skidding propensities. Dealing, however, with artistic design, the article points out that very weak constructive lines are employed in the design, and the fallacy of developing an arc lamp-post with a bent bracket from an architecturally regular column by means of interposing an imitation capital at the top of the column is exposed. The writer suggests that study of some of the old English inn sign posts would be of educational value to the arc lamp-post designer, and it certainly appears as if many of the beautiful structures intended to carry the old sign boards would be amply strong enough in design to serve as models for the greatest modern advertising agency—an arc lamp.

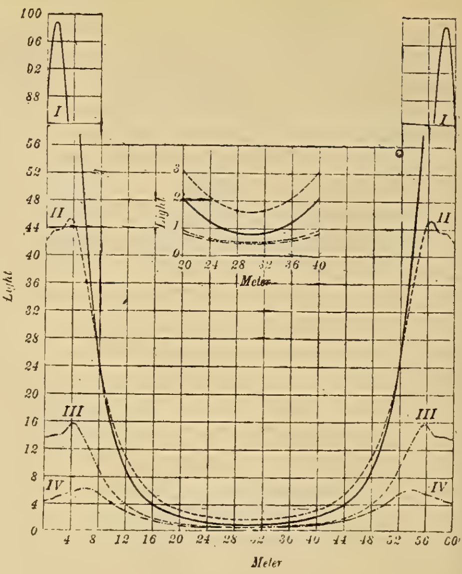


FIG. I.

Cognate to this subject is the recent progress in electric arc lamps, and a very interesting translation appeared recently in *The Electrical Review,* derived from a long article by Dr. B. Monasch in the *Electrotechnische Zeitschrift.* After discussing the history of arc lamp lighting Dr. Monasch gives a series of candlepower illumination curves for lamps of various type, each consuming 825 watts (Fig. 1). The curves show the flame arc (Curve I.), the Blondel arc (Curve II.), the ordinary open arc (Curve III.) and the enclosed arc (Curve IV), suspended eight meters above the ground and 60 meters apart, the plane of readings being 1 meter above the ground. In Curve I. the irregularity factor is 14.1 and energy consumption per average lux 119 watts. In Curve II. the I. F. is 6.4 and consumption per lux 121 watts. In Curve III. the I. F. is 6.4 and the consumption 353, while in Curve IV. the I. F. is 3.9 and consumption 550 watts. Therefore, the street lighting the Blondel arc gives the best all round results as regards uniformity and consumption, though the enclosed arc also gives good uniformity. As regards inside lighting, Table No. 1, compiled by Dr. Monasch and Dr. Bloch, is interesting.

Efforts are continually being made on the part of lamp manufacturers to reduce

the limit of brilliance of each individual metal filament lamp, while at the same time preserving the necessary mechanical strength of filament, in order to meet the demand for a lamp which can be used in an ordinary room without excess light intensity. There are great constructive difficulties in the way of this, and any fresh advance in this direction is, therefore, of peculiar interest. One mode by which the result may eventually be obtained is by the use of a double drum type of suspension, and the way in which the problem is tackled by the Siemens Brothers' Dynamo Works, Ltd., is, therefore, of interest. Their latest lamp consists of a double set of suspenders, the filament being passed through a complete circuit, first round the lower and then round the upper set. In this way great mechanical strength is secured, owing to the shortness of span of each section of wire, while at the same time the greatest amount of light emission is obtained.

Arrangement of lamps.	Aver. illumination in lux 1 m. above the ground.	Watts consumption per average lux and per 100 sq. m. of floor space.
Wholly indirect lighting with the + carbon below	80 to 100	12 to 22
Wholly indirect lighting with the carbons as usual (+ carbon above)	50 to 70	18 to
Semi-indirect lighting	30 to 60	15 to 3[illegible]
Ordinary direct lighting	60 to 70	16 to 25
Nernst lamp lighting	56	44
Carbon-filament incandescent lamp lighting	40	80

THE CHARLOTTENBURG BRIDGE.

Lighting the Most Expensive Bridge in Germany

The most beautiful and most expensive bridge in Germany was opened on April 22 of this year in the city of Charlottenburg. The two colossal columns of sandstone serve as standards for the support of arc lamps, which are suspended from a bronze band near the top, and which furnish the principal illumination for the bridge and its entrance. The regular street lampposts may be seen remaining in their usual positions.

Commercial Engineering of Illumination

An Installation of Display Street Lighting With Gas

By Victor L. Scott.

No subject has been so much talked about during the past year in the field of lighting as the installation of special systems of street lighting for purposes of special display. Many of these have been put in as a result of private enterprise through the agency of boards of trade or business men's associations.

Heretofore the electric light has invariably been used, it apparently never having occurred to the gas companies that they were in the race at all. I could not see the logic nor necessity of such an attitude on the part of gas light. On the contrary, most of the installations which had created such a furore were exhibitions of cast iron and glass ware rather than of model street illumination. In admiring the gorgeous lamp-posts the enthusiastic citizen had neglected to take notice of the comparative darkness of the streets.

Why should not the gas arc, which had long done excellent service in outside lighting in front of individual stores, be utilized for general display street lighting? I took the matter to the general manager of the company with which I had become connected as illuminating engineer—the Portland (Oregon) Gas Company. The manager, Mr. L. A. Klein, after hearing my case advised me to go to Seattle, study the installations there, and prepare to present my case to the property holders of this city. On my return I roughly sketched in pencil the form of post shown in Fig. 1. and asked Artist Bailey to draw it out in proper form. He protested, saying that the design was absurd, but drew it out into a working plan.

Armed with this sketch I proceeded to corral the property owners of Washington street and succeeded in closing what is probably the largest flat rate gas contract in this country with private parties. The Washington street owners contracted for an installation of 100 posts, each carrying three gas arc lamps, as shown in the illustration, the posts to be placed 10 to the block of 200 feet, five on each side of the street. For these the gas company is to receive $7.50 per month for five years. Each post will furnish from 1100 to 1200 candle-power, or about 12,000 candle-power per block of 200 ft. If you will figure this out you will see that it is a much higher illumination than is produced by the tungsten installations of similar character; in fact, it will make Washington street the "Great White Way of the Pacific Coast."

Gas men will be interested to know that this contract was secured in competition with the cheapest possible source of electric current. Current here is obtained from a water power station, and was offered at 3½ cents per kilowatt-hour, with free maintenance of tungsten lamps, which brought the rate for current down to about 1½ cents net.

I may add that we found the regular opalescent globe too easily broken for practical use, and substituted for it a sand-blasted globe. which gives much better diffusion. Separate mains were laid for

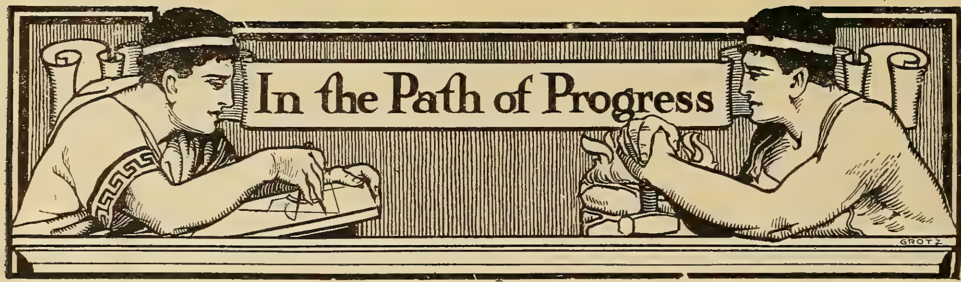
FIG. I.—ORNAMENTAL GAS LAMP STANDARD, WASHINGTON STREET, PORTLAND, ORE.

the installation and a pressure regulator installed on each block, which reduces the consumption of gas to less than 20 ft. per hour for each lamp.

Now that it has been demonstrated what can be done with gas lighting to boom a street, and indirectly the entire city, property owners on other streets are beginning to agitate the matter of better lighting, and it is probable that other installations will follow. All this represents less than 60 days of work.

As there has already been some inquiry from those interested in gas lighting for working details of our plan, Manager Klein states that the Portland Gas Company will furnish full working plans and mechanical data to any one who wishes it.

When one considers how long and successfully the gas arc has been used for outdoor lighting, it strikes one as remarkable that the gas companies have so entirely missed their opportunity in the present movement for display street lighting. They seem to have let the matter go entirely by default. High pressure gas lighting is reported to be largely used in European cities for special installations, but it is not at all necessary that we wait for the development of this method in order to secure a fair share of the improved street lighting in this country. The gas arc just as we have it, as demonstrated in the present case, is quite capable of entering into successful competition with the best forms of electric lamps now in existence.



A Device for Promoting Tungsten Street Lighting

The advantages of the low voltage series tungsten lamp for street lighting need not be set forth here; every electrical engineer is perfectly familiar with them. It is simply a question of practicability. To operate the system successfully necessitates an automatic cut-out device, by means of which the line current will be continued and the energy of each individual lamp compensated for in case of breakage of the filament. A simple device for meeting this condition is offered by Mr. J. H. Hallberg, of 30 Greenwich avenue, New York City. This device is illustrated below, and is thus clearly described by Mr. Hallberg:

The Hallberg cut-out is waterproof and mounted in solid oxidized copper case, with all parts carefully designed, constructed and insulated.

Within the cut-out case is a shunt winding of exceptionally high resistance relative to the lamp. This winding diverts less than one hundredth of an ampere from the lamp. In case of lamp breakage, however, the shunt winding exerts a powerful pull on an armature, which trips the compensating unit into circuit through silver lined contacts of large capacity.

THE HALLBERG CUT-OUT.

This device should have a considerable influence in promoting the better lighting of streets and parks by the use of this most efficient of all systems of incandescent electric lighting.

Hand-Decorated Globes and Shades

French and Bohemian glass has long been famous the world over for the beauty of its decoration. Glass decorating was brought to a high state of perfection in Bohemia centuries ago, and has been to a greater or less extent a secret transmitted from father to son through many generations. On account of this hereditary talent and long experience, together with the cheapness of living in that country, Bohemia has succeeded in holding the markets of this country for its wares even in the face of a high duty. There has been little attempt to put hand decorated ware of American manufacture upon the market.

The Consolidated Lamp and Glass Company, of Coraopolis, Pa., who are veterans in the shade business in this country, would seem to be flying in the face of tradition, if not of Providence, by putting out a full line of hand-painted shades which are the product of American artisanship—but they have the courage of their convictions. In mechanical effects America has always been far in the lead, but there is an individuality and distinctness about free hand work which no mechanical device can approach. It is the difference between handwriting and typewriting or printing. It always expresses

more than the possible symbols. Those who appreciate this quality of individuality and personality in decorative art will be pleased to examine this American innovation of the Consolidated Company.

Tantalum Lamps for Railway Car Lighting

That the subject of lighting railway cars is being given the recognition which its importance demands is evidenced by the flourishing condition of the Car Lighting Engineers' Association, which has recently held its successful second annual convention. In considering the subject street and interurban electric cars must be included as well as passenger coaches on steam railways.

Whatever may be the actual arguments in favor of gas lighting, and they are not a few, the fact is plainly evident that the tendency for all classes of car lighting in this country is toward electricity. The electric light in America seems to have something of the prestige attaching to it that the European gives to a coat-of-arms —it is a mark of quality. In the case of electrically propelled cars, of course, no other form of light is to be considered for a moment, and the use of electricity on steam-driven cars is undoubtedly making very rapid headway.

The question of the best form of lamp for the purpose, therefore, assumes importance. In all cases a good quality of illumination and durability in the life of the lamp are prime requisites. In the case of steam-driven cars where, so to speak, a central station has to be put upon wheels, the question of efficiency also is of great importance. It is to be expected that seriour efforts would be made to adapt the newer forms of metallic filament lamps for railway service. The Buckeye Electric Company, Cleveland, Ohio, seems to have been successful in producing a tantalum lamp for railway service that offers many advantages. These are produced in two sizes, 16 and 32 candle-power, and have a consumption of 2.3 watts per candle, which is a very material reduction from the 4 watts per candle, which was the average with the carbon filament type.

THE BUCKEYE TANTALUM LAMP FOR RAILWAY CAR LIGHTING.

Besides its advantage in higher efficiency the tantalum lamp also has a less variation in candle-power with fluctuations of voltage, a point of no inconsiderable advantage in railway work, where there are necessarily comparatively large voltage variations.

Lastly, it is claimed, apparently on substantial evidence, that the tantalum filament is less susceptible to mechanical breakage than the carbon filament. The lamp, therefore, presents on the whole a distinct advance in electric car lighting.

Testing Electrical Measuring Instruments

The Bureau of Standards, Washington, D. C., has issued a pamphlet under the above title, which is Bureau Circular No. 20. This is a very comprehensive and authoritative treatment of the subject, and may be had free upon application to the Bureau.

Besides describing the various constants and instruments for their measurement a full schedule of fees for making the various tests is given, also a list of publications dealing with electrical measurements. Those having occasion to use such instruments will do well to procure a copy of this circular.

Alaska-Yukon-Pacific Exposition Prizes

The General Electric Company, Schenectady, N. Y., announces that it has received grand prizes, which are the highest award given, at this Exposition in each class of electrical apparatus in which an exhibit was made by the company. Among these were incandescent electric lamps.

Proceedings of Technical Societies

Papers Presented at the Third Annual Convention of the Illuminating Engineering Society, Held in New York City, September 27, 28 and 29

The Ethics of Illuminating Engineering. By E. L. Elliott.

The author divides the subject into two divisions: the relation of the engineer to his client, and the relation of the engineer to his fellow engineers. Under the first division the following propositions were laid down: The consulting engineer is entitled to compensation for advice given as the result of special knowledge on the particular subject treated. Where there is no special knowledge there is no ethical basis for a fee. On this point the writer pointed out the necessity of some recognized standard of proficiency in the illuminating engineering profession. The two factors which determine the amount of the fee for advice are the extent and accuracy of the engineer's knowledge, and the benefit which a client will receive from the advice. A fee contingent upon the saving in illuminant effected by the engineer's advice the writer considers very questionable, for the reason that it offers an incentive for fraudulent practice.

An illuminating engineer should not serve two clients who are close competitors, nor can he offer his services in a consulting capacity if he is under a retaining fee with a manufacturer of luminants or lighting appliances, except to advise in regard to the use of such luminants or appliances as are manufactured by the client retaining him. An illuminating engineer cannot ethically offer to give free consulting advice when retained by a manufacturer, except his connection be well known, and it be understood that his advice is primarily in the interests of the client retaining him.

A consulting illuminating engineer may also do construction work, but in such cases the profit on the work should be made a distinct item from any fee for consultation, or laying out plans. A constructing illuminating engineer should not act in a consulting capacity if he has any financial interests in the material used.

In regard to the relation of the engineer to his fellow engineers, no effort should be made to secure work known to have been already secured by another engineer, or to criticise an installation that has been put in by an engineer for the purpose of securing the contract for remodeling it. Every member of the illuminating engineering profession should contribute as far as possible to the general knowledge and progress of the science.

The Work of Dr. Carl Auer von Welsbach in the Field of Artificial Illuminants. By George S. Barrows.

Mr. Barrows traced the work of Dr. Welsbach from his earliest observations on the peculiar light-giving properties of the rare earths until the present day. He described not only the remarkable chemical discoveries that revolutionized gas lighting, but also traced the history and progress of the commercial exploitation of these discoveries. He also gave a brief outline of the work of Dr. Welsbach in the field of the metallic filament electric lamp. The paper brings together in a compact and interesting form the principal events in the life of this remarkable scientific investigator, and places them in a convenient form for reference.

The Progress of Illuminating Engineering in Europe. By H. Thurston Owens.

The author refers particularly to the founding of *The Illuminating Engineer* by Mr. Leon Gaster, in London, January 1, 1908, also the Cantor lectures given before the Royal Society of Arts by Mr. Gaster during the past winter. The formation of the British Illuminating Engineering Society is also an accomplished fact; so that illuminating engineering may be fairly said to have secured a recognized position in England. A very brief review of the street lighting in a number of European cities is given, particular attention being called to high pressure gas lighting.

Diffusing Mediums. By Albert J. Marshall.

The writer particularly objects to the use of plain frosted or sand-blasted glass globes, especially where more than one electric lamp is placed within, his objection being that the bright spots of light produced by the filament are objectionable in themselves, and particularly so when unsymmetrically placed in the globes. He suggests opal glass depolished by etching, or sand blasting, or slightly depolished prismatic glass. The writer also makes a general plea for more attention to the subject of glassware in connection with lighting fixtures, pointing out the absurdity of placing glassware of some particular design upon a fixture having a totally different motif in its artistic conception. A more definite method of specifying the different varieties of diffusing glass, such as opal, opaline, etc., is also urged.

Illuminating Engineering from the Educational Standpoint. By F. K. Richtmeyer.

The writer, who is an instructor in physics in Cornell University, points out that an educational institution has a twofold purpose—to furnish instruction in the fundamentals of the various subjects, and to direct and carry out original research. Fulfilling the former of these purposes, general courses in photometry and allied subjects should be given as a basis for the specialized work of the illuminating engineer. The courses offered along this line at Cornell University are given. The importance of research work which, generally speaking, can only be done in connection with college or university facilities, is also emphasized; it is by such work that all specialized branches of engineering must depend for their ultimate advancement.

The Photometrical Laboratory of the United Gas Improvement Company. By C. O. Bond.

The laboratory described by the author is undoubtedly the finest of its kind connected with any gas company in this country, if not in the world. As the equipment of this laboratory was begun during the past year, and is not yet completed, it shows the remarkable increase in importance attached to the work of photometry and standardization by the gas industry. The laboratory occupies an entire two-story and basement building, 26 x 100 ft. in dimensions, and contains special gas holders, compressors, calorimeters and the most modern photometrical apparatus, together with certified primary standard light-sources from several European as well as American authorities. From the description given it would seem that nothing has been omitted, at least in the general plan as laid out, that could in the slightest way aid in the investigation of the properties and use of illuminating gas for every possible purpose. The laboratory is located at the Point Breeze, Philadelphia, Gas Works.

The Physical Laboratory of the National Electric Lamp Association. By Dr. Edward P. Hyde, Director.

The introductory paragraph of Dr. Hyde's paper is the clearest and most succinct statement of the principles of illuminating engineering that has perhaps ever appeared:

> The inception and development of the science and art of illuminating engineering constitute an epoch in the progress of civilization. Its principles rest on the correlation, after a new scheme, of the scattered phenomena of the ancient sciences of physics, physiology and psychology and the dictates of the ancient art of architecture. Its accomplishments depend on the application of its principles to the solution of practical problems of lighting. One of its most attractive and yet most perplexing features is its very

complexity. The phenomena and laws of the sciences of physics, physiology and psychology are well established; the dicta of the art of architecture are well formulated; the correlation of these laws and dicta as a basis of practical application to lighting is a distinct achievement of the new art and science from which this society has taken its name.

Dr. Hyde then describes briefly the ideals which underlie the Physical Laboratory of the National Electric Lamp Association, which is undoubtedly the most unique and significant institution ever established by a purely commercial corporation. Broadly speaking, it is a general research laboratory, working on broad and absolutely unrestricted lines, and occupied in investigating the most abstruse problems of pure science. The careful student of science knows that all practical applications, which are the basis of modern commercial life, have their origin in just such theoretical investigations. The remarkable aspect of this particular case is that the more or less remote connection between pure and applied science should be so fully recognized by men whose tastes and energies have been entirely confined to commercialism. As an example of broad-minded, far-seeing business acumen, the founding of the laboratory of the National Electric Lamp Association is without a parrallel.

The general plan thus far laid out involves the division of the work into three general classes of problems; first, those that have to do with the production of luminous energy; second, those that have to do with the utilization of luminous energy; third, those that have to do with the effects of luminous and attendant radiation. While each of these departments will overlap, it is proposed to have a trained specialist in charge of each. These have already been chosen as follows: Mr. F. E. Cady, Division I.; Dr. Herbert E. Ives, Division II.; Dr. Percy W. Codd, Division III.

The laboratory has already been equipped with the necessary mechanical apparatus for instrument making, and photometric and other apparatus of the most modern type was purchased by Dr. Hyde in Europe during the past summer, and will be installed as rapidly as received. Those who have had a personal acquaintance with the several specialists will have no doubts as to the high quality of work which will be carried on under Dr. Hyde's direction in this remarkable institution.

Notes on Chemical Luminousness of Rare Earths. By Dr. Angelo Simonini.

Dr. Simonini is one of Dr. Welsbach's chief assistants, and has been familiar with his work from the beginning. He gives in this short paper results of experiments carried out some fifteen years ago, and derives therefrom a theory for the phenomena of luminescence of the Welsbach mantle.

The Light of the Firefly. By Dr. H. E. Ives and W. W. Coblentz.

After referring to the original work of Professors Langley and Berry and describing accurately their methods of investigation, the writers draw from their own investigations the following very interesting conclusion as to the relative efficiencies of the light of the firefly and that of incandescent electric lamps.

The efficiency of the light of the carbon filament lamp is .43 per cent.; in other words, of all the energy consumed only .43 per cent. is converted into light. The tungsten lamp has an efficiency of 1.3 per cent., and the mercury arc 3.8 per cent. The efficiency of the light of the firefly is 96.5 per cent. Making the comparison in another form: the carbon filament lamp has an efficiency of 83 watts per mean hemispherical candle; the tungsten lamp 1.6 per cendle, and the metallic arc .55 watts per candle. In comparison with these the firefly has an efficiency of .02 watts per candle.

Allowable Amplitudes and Frequencies of Voltage Fluctuations in Incandescent Lamps. By Dr. Herbert E. Ives.

The title of this paper indicates the highly technical nature of the discussion. In its practical application the investigation was directed toward determining the conditions under which incandescent lamps would produce a perceptible flicker when run on alternating current of different frequencies. The author finds that the lamps requiring the highest frequency to prevent flicker are the tungsten 25 and 40-watt. Those permitting the lowest frequency are the series lamps. This was to

be expected, since the rapidity of heating and cooling must be dependent upon the thickness of the filament.

The Principles of Shades and Reflectors. By Dr. Louis Bell.

In this paper Dr. Bell has drawn in an exceptionally clear and understandable manner the general principles affecting the performance of reflectors. His exposition of the effect of depolishing prismatic reflectors is particularly lucid, and should dispel any misconceptions on this point that have heretofore existed. A careful reading of this paper will put even the layman in possession of the principles of reflection to such an extent that he could become a competent judge of the relative merits and demerits of the various types of shades and reflectors found upon the market.

Standard Relations of Light Distribution. By Arthur J. Sweet.

The writer likens the first stages of illuminating engineering to the pioneer laying out highways in a new country, and rightly claims that if this new science is to become an actual power for general good its principles must be reduced to standard formulæ and tables which can be used by the non-professional as well as the trained engineer. To carry this purpose a step further the author shows the theoretical solution of a number of typical problems, and gives ideal distribution curves for lighting units which will produce the desired results under given conditions. These curves are intended to serve as guides in the selection of proper lighting units in the various practical problems that may arise.

In the summary the author says:

> When the commercial interests furnish light units giving the three correct distributions, the problem of illumination design in what are frequently its most important factors—relative intensity of illumination, average intensity and total number of light units required—will be reduced to the simplicity of a table which can be applied to concrete, practical problems by any intelligent man. When that day comes, we shall find correct illumination the rule in the home, the office and the store, and not, as at present, the rarely-met-with exception.

The Problem of Heterochromatic Photometry. By Preston S. Millar.

The problem which Mr. Millar discusses derives its practical importance from the varying colors of present commercial light-sources. This complication seems likely to increase rather than decrease. The practice of using the flame as a primary standard, and particularly a flame of such reddish color as the standards now accepted, also has an important bearing on the photometry of sources of such whiteness as the tungsten lamp and the incandescent gas mantle. The paper gives the results of a number of experiments carried out at the Electrical Testing Laboratories, with different observers and different instruments. The results show that the range of discrepancies was in some cases very considerable. The conclusions of the paper are as follows:

> From the foregoing considerations it appears that very serious discrepancies are encountered in commercial practice where the illuminants tested differ in color from available standards of luminous intensity. There seems reason to hope, however, that in the transfer of our candle power unit from its present color to that of, say, the tungsten lamp, no insurmountable difficulties will be encountered, provided that a sufficient number of experienced observers co-operate in making the determinations.
>
> To-day the candle power of a tungsten lamp or of a mantle gas lamp may be stated with fair accuracy, although not so accurately as the conditions really demand. Tests of illuminants whose color values differ largely from the color values of standard lamps are uncertain to a degree which is beyond the limits allowable in good engineering practice.

Some Results Obtained Through Illuminometry. By Norman Macbeth.

The writer gives the results of measurements taken with the Sharp-Millar illuminometer in a room especially fitted up for the purpose at the factories of the Welsbach Company. A portion of the room, 12 x 20 ft., was curtained off and lined with black. A four-light inverted mantle fixture was put up, and illuminometer measurements taken at planes 4, 6 and 8 ft. below the light-source. The values thus found by actual measurements are then compared with the theoretical values, and several methods are described of de-

termining the lumens efficient within a given zone.

Factory Lighting. By L. B. Marks.

The writer gives a very complete review of the lighting conditions, both daylight and artificial, in four machine shops doing small, accurate work, and a silk ribbon factory. In all these localized lighting was used for the artificial illumination. The paper contains much new and valuable data of a kind of which exceedingly little has ever been published. The author's conclusions are as follows:

1. The illumination produced by each lamp is confined to a very small zone which is brilliantly illuminated, while contiguous parts of the working space where good light is needed, are in comparative darkness. The actual intensity of illumination directly underneath the lamps is in most cases several times as much (often from five to ten times as much) as is desirable to secure the best vision.

2. With the localized system of illumination as installed in these factories, there is a maximum of direct (harmful) reflection of light from the working parts of the machines. Owing to the location of the lighting source with reference to the object illuminated, a considerable percentage of light from the lamp is reflected directly from the work to the eye of the operator.

3. In a system of localized illumination such as is employed in these factories, it is necessary to frequently readjust the height and position of the lamps to suit the requirements of the work. The drop lamps are necessarily placed quite close to the work. Each operator adjusts the position of his lamp close enough to his work to give an illumination which is satisfactory to him. As a result of this practice it sometimes happens that the operator, in order to secure suitable illumination on his work, may so adjust his lamp that part or all of the light therefrom shines directly into the eyes of his neighbor.

4. The frequent handling of the lights by the operators to adjust the height and position of the lighting units, results in soiling the lamps and reflectors. It is not unusual, in most of the departments, to find finger marks on the glass bulbs and on the reflecting surface of the shades, which latter are in many instances so smutted from handling that they are practically worthless as reflectors.

5. The frequent adjustments and readjustments of the lights unnecessarily occupy the time of the operator and to some extent distract his attention from his work.

6. The multiplicity of dangling wires from the drop lamps presents an unsightly appearance. Moreover, those wires are apt to be in the way of moving parts of the machinery, etc.

7. In some cases the eyes of the operator are very close to the reflector and are affected by the heat of the lamp.

8. Objectionable shadows are cast by the reflectors, lamp supports, drop-cords and hangers.

9. The shops present a gloomy appearance at night. Even when all of the local lamps are in operation, the intensity of the general illumination on the working plane in locations outside of the restricted field illuminated by the drop lamps, is at best only about ¼ ft. candle, being less than 1-7 ft. candle in most of the departments, and in some less than 1-30 ft. candle, as shown by the measurements given in the tables.

10. The extremely low degree of general illumination in the shops makes it difficult if not impossible for the foreman to exercise the same character of supervision at night as he does in the daytime, and makes it more difficult to guard against factory accidents.

11. With the present system of localized illumination in the shops, advantage cannot be taken at night of the reflecting and diffusing value of the walls and ceilings, whereas in the daytime the walls and ceilings are used to great advantage in reflecting and diffusing natural illumination.

Operating Efficiencies of Some Commercial Installations of Lighting Systems. By A. L. Eustice.

This paper is along the lines of investigation which the author has been following now for more than a year, and is a further report of experiments directed toward ascertaining the actual working efficiency of various lighting systems under the conditions of maintenance that actually exist. The general conclusion shows the necessity, or at least the commercial advantage, for reasons of efficiency for keeping lighting units clean. The maximum increase in an installation due to cleaning was found to be 40 per cent. According to the author's observations the tungsten lamp unit is much more effected by the natural accumulation of dust than the Nernst lamp.

Tests of the Moore Tube Lighting Installation in the New York Post Office. By Dr. E. P. Hyde and J. E. Woodwell.

This is a report of tests conducted in June, 1908, by the Bureau of Standards, at the request of the Treasury Department, on two Moore tube "hair-pin units" in the registry room of the New York Post Office. The tubes were the standard nitrogen gas tubes. The test involved five different series of observations; first,

illumination measurements at various stations to determine the quantity and uniformity; second, measurement of energy and power factor; third, determination of flux of light; fourth, stroboscopic determination of variations in illumination throughout a cycle; fifth, study of color.

The several measurements developed the fact that the tubes were operated with a power factor of 63 to 69 per cent., and that the efficiency was 5.21 lumens per watt. The watts per mean hemispherical candle-power for one of the tubes was found to be 2.42. One of the most interesting points brought out was in connection with the stroboscopic test. It was found that by running two adjacent tubes on phases 90 degrees apart, the variation in intensity, which measures the amount of flicker, could be cut down from a ratio of 8 to 1 to 2 to 1, thus almost completely eliminating this one serious objection to the Moore light.

Tests of a Moore Tube. By Dr. Clayton H. Sharp and P. S. Millar.

This paper reports tests made upon a Moore Tube installed in one of the assembly rooms of the United Engineering Societies' Building, this installation having been especially made to illustrate the paper on the subject read by Mr. Moore before the American Institute of Electrical Engineers. The purpose of the test was primarily to determine the value of the Moore Tube as a luminant, and particularly to discover what its commercial efficiency is. According to this test, the power factor was 73 per cent., the efficiency of light production 5.5 lumens per watt, and watts per equivalent mean hemispherical candle-power 2.49. The writers, therefore, place it as practically equivalent in efficiency as a light producer as the tantalum lamp.

Conventions

The Colorado Electric Light, Power and Railway Association held its annual convention at Denver, beginning October 7th. Mr. J. R. Cravath, of Chicago, gave a talk, illustrated with blackboard drawings, on "Recent Progress in Illuminating Engineering."

The Association of Car Lighting Engineers held its second annual convention in Chicago October 4th to 7th. Among the papers presented was one by Dr. Max Buttner on "Electrical Train Lighting on European Railroads."

The Pacific Coast Gas Association held its seventeenth annual convention in San Francisco, September 21, 22 and 23. In the field of illuminating engineering a paper on "Effective Gas Lighting" was presented by Mr. R. J. Thompson. Mr. Thompson treats the subject in a thoroughly practical manner, and his paper should be in the hands of every gas company solicitor.

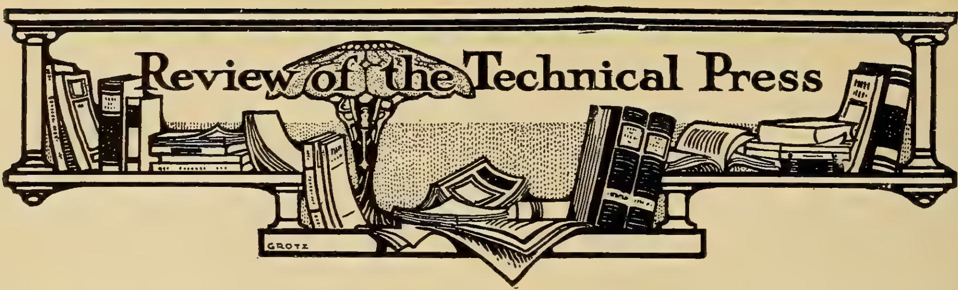
He spoke as follows:

The persons designing or constructing buildings are often responsible for the wasteful use of light. Very often the details of the piping for gas, the number, size and position of the outlets, receive very little consideration, and the matter is often placed in the hands of the plumber or his assistant. In a small house one is apt to find the library lighted with a single outlet in the center of the room, with no provision for wall brackets; the kitchen, with an outlet between two windows; the bedroom, with an outlet in the center of the room, so that the chandelier will hang directly over the foot of the bed and bracket outlets placed to come behind the bed.

The Northwestern Electric Light and Power Association held its convention at Seattle September 7, 8 and 9. Among the papers presented was one on "Illuminating Engineering from a Central Station Standpoint," by Mr. W. M. Hamilton. The paper deals with the subject in a fairly exhaustive manner, and is a valuable contribution to the subject which every central station manager should be familiar with.

He opened his paper as follows:

Illuminating engineering from a central station standpoint is very largely a commercial proposition. To begin with, the central station man who is engaged in illuminating engineering work for his company must always remember that he is not in the position of a regular consulting engineer, employed by the party for whom he is laying out the installation, and that the compensation for his services is not to be a certain percentage of the cost of the installation or some fixed amount, but that the compensation is to be derived through the medium of the sale of current, and is exactly proportional to the amount of increased revenue obtained in this manner due to his work.



American Items

White Light from the Mercury Arc and Its Complementary, by Dr. H. E. Ives; *Electrical World*, September 23.

The article gives the experimental results obtained by Dr. Ives in an attempt to discover the proper complementary light to produce a pure white light in connection with the mercury arc. The subject was investigated by means of the Ives colorimeter. The proportionate quantities of other light required for this purpose were found to be as follows: to one candle-power from a mercury arc lamp should be added to make white .57 candle-power of Welsbach, .54 candle-power of tungsten, or .5 candle-power of 3.1 watt carbon lamp. Therefore, one may say that to the light of a mercury arc a little over one-half the candle-power of Welsbach, tungsten or carbon lamp must be added to secure white.

Luminosity and Temperature, by P. G. Nutting, *Electrical World*, September 23.

A highly technical treatment of the subject, mostly from the mathematical standpoint.

Design of Illuminating Installations Using Luminous Tubes, by M. D. Cooper; *Electrical World*, September 23.

A rather lengthy discussion of the subject based upon mathematical considerations.

The Hudson-Fulton Celebration in New York City; *Electrical World*, September 30.

The article is devoted to a description of a number of illustrations of the spectacular lighting during the celebration.

Industrial Plant Illumination with Tungsten Lamps, by Arthur Gillman; *Electrical World*, September 30.

Sets forth the advantages of this new form of electric lamp for commercial lighting, and shows a device for preventing vibration from destroying the filaments.

Illumination of Shop Yards by Means of Tungsten Lamps, by Arthur Gillman; *Electrical World*, October 14.

Devoted principally to showing weather proof devices for using tungsten lamps for exterior lighting.

Street Lighting in Budapest, by Francis Jehl; *Electrical World*, October 21.

Describes the installation of Blondell arc lamps used in this city.

Street Lighting Experiments in Liverpool, by Glenn Marston; *Electrical World*, October 21.

A short article describing the recent experiments in the use of new luminants in street lighting.

The Absolute Standard of Light, by Joseph H. Hart; *Electrical Review and Western Electrician*, September 25.

Sets forth the possibility of using sunlight as an absolute standard.

Light and Illumination: Esthetic

Considerations, by Albert J. Marshall; *Light,* October.

This is Chapter VIII. of Mr. Marshall's series of contributions. He expands his favorite theme of the illuminating engineer, giving more attention to esthetics. It will be difficult to persuade the profession, as well as the public, that engineering is essentially a branch of esthetics, although they may agree with Mr. Marshall as to the importance of the latter subject.

Tungsten Lamps for Street Lighting; *Electrical Record,* October.

Points out the advantages of using this form of lamp in place of arcs.

Window and Store Illumination, by Edward P. Oliver; *Merchants' Record and Show Window,* October.

The article, which is short, is largely devoted to setting forth the importance of good lighting for stores and show windows. On the question as to how to secure the best store illumination the writer advises merchants to secure professional advice.

Lighting of Churches, by Bassett Jones, Jr.; *American Architect,* September 22.

The writer disclaims at the beginning any intention of setting down hard and fast rules for the illumination of churches, claiming that they vary so much in architecture and construction that each forms a problem in itself. A very scholarly discussion of the subject then follows, illustrated with numerous photographs and drawings. The article is one of the most valuable on the subject that has appeared.

Lighting Experts; *Progressive Age,* October 15.

An editorial containing much sound advice for the gas lighting interests.

A New System of Car Illumination, by H. C. Meloy; *Railway Electrical Engineer,* October.

The system described represents the first attempt made, so far as we are aware, to illuminate a railway coach along modern ideas of illuminating engineering. The system consists in placing electric lamps with efficient reflectors behind a false ceiling on top of the car. The bottom of the reflector is then covered with a sheet of prismatic glass arranged to distribute the light in the proper direction. The method is worthy of the most careful consideration of those dealing with this most neglected problem of illuminating engineering.

Incandescent Train Lighting Lamps, by Henry Schroeder; *Railway Electrical Engineer,* October.

Describes the various types of incandescent electric lamps, especially designed for this service.

Flame Arc Lamps, by Clayton and Craig; *Gas and Electric Fixture Trade Review,* September.

Describes metallic arc lamps for direct current series circuits.

The Tungsten Lamp, by T. A. Tillary; *Southern Electrician,* October.

A short article dealing with the relation of the tungsten lamp to central station policies.

Foreign Items

Compiled by J. S. Dow.

ILLUMINATION AND PHOTOMETRY.

Nouveaux Procédés d'Eclairages, by A. Bainville (*L'Electricien,* Aug. 28).

Verres protecteurs contre les rayons ultra-violets de MM., le docteur oculiste F. Schanz et l'Ingenieur Stockhausen, by J. A. Grand (*Le Gaz,* September).

The Deleterious Effects of Bright Light on the Eyes (*J. G. L.,* Aug. 31).

La Qualité des differents luminaires (*Jour. de l'Union des Appareils à Acetylene,* July-August).

These four articles deal mainly with physiological matters. That by Bainville reviews the most recent modern illuminants and gives some particulars of their intrinsic brilliancy.

The second, by Grand, is a paper delivered at the annual meeting of the Sociétè Technique de l'Industrie du Gaz, and consists of a résumé of the work of Schanz and Stockhausen on ultra-violet light and the use of Euphos glass.

The third is an abstract of the article by Dr. H. Parsons, mentioned in the last review, which is also mainly concerned with intrinsic brilliancy and the effects of ultra-violet light.

The fourth article briefly refers to the experiments of a Russian observer who has attempted to study the fatiguing effect of different illuminants by observing the number of times that the eyes wink per minute in the different cases.

Light in Worship, by Dr. M. Gaster (*Illum. Eng.,* London, September).

The author shows how the reverence of primitive peoples for the sacred nature of fire gradually gave rise to modifications in the religious ceremonies of ancient Greece and Rome and other nations in different parts of the world. Of special interest to the illuminating engineer is the reference to the methods of illumination on special occasions in temples, etc.

Observations and Advice on Shop-Lighting (*J. G. L.,* Sept. 7).

An article discussing the application of illuminating engineering principles to shop lighting. The author comments upon the unsatisfactory nature of mere empirical rules. The quality of illumination needed for different kinds of work varies considerably, and, it is also pointed out, the degree of illumination necessary or desirable in a room devoted entirely to heavy dark materials in a draper's premises will be different from that in a section given up to goods which are light in texture.

Tests on Motor Car Headlights (*Illum. Eng.,* London, September).

A series of tests carried out by the Royal Automobile Club, with the object of ascertaining the best types of motor lights for motor cars and other rapidly driven vehicles. What is required is a bright and penetrating light, coupled with as little glare to pedestrians as possible. A large number of lamps are described and classified.

Illumination in the Middle Ages, Up to the Nineteenth Century, by L. von Benesch.

A recently published work, devoted to ancient forms of fixtures and the record of primitive methods of lighting in the past, which is reviewed in the London *Illuminating Engineer.* The book is illustrated by a singularly complete and well got up series of plates, showing the various types of fixtures described.

The Reputed Candlepower of Lamps, by W. Wissmann (*G. W.,* Sept. 4).

This is a translation of an article in a German periodical. The author points out the great uncertainty which follows the present loose methods of describing the candlepower of lamps without stating definitely whether the ray in any particuar direction or the M. Sph. C. P. is intended. He states that the rules advocated by the German Institution of Electrical Engineers are being considered by the gas industry in Germany and will probably be adopted, with suitable modifications.

Illumination: Its Distribution and Measurements, by A. P. Trotter, continued (*Illum. Eng.,* London, September).

In the present section of his serial article the author gives a short account of the Joly photometer, and also describes the mode of action and principle of the Abney rotating sector.

The Photometry of Tungsten Lamps and the Flicker-Photometer, by J. S. Dow (*Illum. Eng.,* London, September).

The author refers to the experience of L. Wild, who has found that photometers of the flicker and equality of brightness pattern give different results when applied to the photometry of tungsten lamps. He describes some experiments intended to lead to information on the physiological

principle underlying such instruments, and suggests a theory to account for the results obtained based on the theory of the action, the rods and cones on the retina.

DIE STRAHLENGESETZTE LEUCHTENDER FLÄCHEN, by E. W. Weinbeer (Schweiz, *E. T. Z.*, Aug. 7).

ELECTRIC LIGHTING.

EINE UNIVERSALLAMPE MIT PARALLELEN KOHLEN SELBSTREGULIEREND OHNE REGELWERK, by Bermbach (*E. T. Z.*, Sept. 2).

An account of a new form of arc lamp which is stated to utilize practically no regulating mechanism.

ELEKTRICITÄT IM WOHNHAUSE, by Dr. L. Bloch (*A. E. G. Zeitschrift*, September).

Deals in a popular manner with applications of electricity in dwelling houses; a number of different types of fixtures are shown and some sound advice is given regarding the use of light by the private consumer to the best advantage.

EDITORIAL: THE CANDLEPOWER OF METALLIC FILAMENT LAMPS (*Electrician*, Sept. 17).

Complains that imported metallic filament lamps often prove not to give the rated candlepower. This is thought to be partly due to the fact that such lamps are frequently graded in Hefner candles; but even so, they come out too low. Some method of standardization is needed.

DIE WEITERE ENTWICKLUNG DER METALLFADENLAMPEN AUF GRUNDE DER ERFAHRUNGEN DES LETZTEN JAHRES, by A. Libesney (*E. T. Z.*, Aug. 19).

Summarizes the progress in metallic filament lamps in the last year. A series of curves are given illustrating, among other things, the connection between the life and specific consumption of a tungsten filament. The author concludes that efforts to produce a lamp running at under 1 watt per H. K. have as yet failed; at present manufacturers are mainly directing their efforts toward extending the range of candlepower obtainable at a given voltage.

WIE KANN DIE WIRTSCHAFTLICHKEIT EINER ELEKTRISCHEN BELEUCHTUNGSANLAGEN GÜNSTIG BEEINFLUST WERDEN, by G. Werner (*Z. f. B.*, Aug. 30).

The author divides consumers into three broad classes: those who are mainly anxious to get light cheaply, those who desire a good light, but are also influenced by considerations of cost, and those who are only keen to get the most perfect system of illumination, irrespective of expense; he also describes a new form of portable photometer and indicates its sphere of usefulness.

STATUITS DE L'ASSOCIATION POUR L'ACHAT DE LAMPES À INCANDESCENCE (*Schweiz, E. T. Z.*, July 17).

Publishes the regulations of the association of engineers in Switzerland concerned with the purchase of glow lamps. The work of the association will consist partly in estimating the probable required output for the coming year and arranging for purchase on the best terms.

ELEKTRISCHE GLÜHLAMPEN MIT KLARBLEIBENDEN GLASBALLONS (*Oesterr.-Ungar. Installateur*, Aug. 7).

Describes a modification in the process of evacuating lamp-bulbs which, it is contended, prevents subsequent blackening.

RECENT PROGRESS IN ELECTRIC LIGHTING, by B. Monasch (*Elec. Rev.*, Aug. 27).

An abstract of the article by this author in the *E. T. Z.*, previously referred to in these reviews; the article deals in a general manner with recent developments in arc lamps.

THE CAUSE OF THE OFFENSIVE ODOR OF MERCURY VAPOR LAMPS (*Elec. Engineer*, Aug. 27).

ELECTRICAL SUPPLY TRIALS FOR SHOPKEEPERS (*Electricity*, Aug. 27).

ARCLAMP STANDARDS (*Electricity*, Aug. 27).

THE MANUFACTURE OF TUNGSTEN FILAMENTS (*Elec. Engineering*, Sept. 10).

A NEW DESIGN OF ENCLOSED ARCLAMP (*Elec. Engineering*, Sept. 10).

THE TAXATION OF ELECTRIC LAMPS (*Elec. Engineer*, Aug. 27).

THE NEW B. O. T. REGULATIONS (*Elec. Engineer*, Aug. 27).

DIE THAUMALAMPE (*E. T. Z.*, Sept. 16).

GAS, OIL, ACETYLENE LIGHTING, ETC.

ALLUMAGE ET EXTINCTION DU GAZ À DISTANCE, by Aubert, Aublant, etc. (*Le Gaz*, Sept.).

GAS-ZÜNDVORRICHTUNGEN (*Z. f. B.*, Sept. 10, 20).

Both the above articles refer to the automatic control of gaslights at a distance. The first reference is to several papers read at the recent annual meeting of the Société Technique de l'Industrie du Gaz, in France. The latter forms part of a series that has been appearing in the *Zeitschrift für Beleuchtungswesen.* The present installment deals with devices involving a temporary change of pressure at the mains.

PRESSGASBELEUCHTUNG, by R. Bremer (*Z. f. B.*, Aug. 30, Sept. 10).

This is a general article summarizing progress in incandescent gaslighting since the days of the flat flame burner. Special attention is given to the steps in the recent developments in Berlin, and allusion is made to several difficulties which were only got over by the joint efforts of the laboratory of the city, of the Selas Co., and Messrs. Ehrich and Grätz. For instance, great breakage of globes was originally experienced until one large mantle was replaced by three small ones.

It is interesting to observe that the pressure gas is supplied from six separate central stations, but it is proposed to interconnect the mains from each station so that a common constant pressure may be maintained in the whole city.

NOTES ON INCANDESCENT GASLIGHTING, by Dr. C. R. Böhm (*Illum. Eng.*, Lond., Sept.).

The conclusion of the serial article by this author which deals mainly with recent developments in processes connected with the manufacture of artificial silk mantles.

METALLIC FILAMENT GASMANTLES, Editorial (*J. G. L.*, Sept. 14).

Short note referring to the metallic filament mantles mentioned in the last review.

HIGH DUTY GASLIGHTING, by T. Holgate (*Illum. Eng.*, Lond., Sept., Concluded).

THE LIGHTING OF BLACKFRIARS BRIDGE, LONDON (*G. W.*, Sept. 10).

Refers to the alteration in the lighting of this bridge, which is now to be accomplished by high pressure at 54 inches of water.

THE AIROSTAT INVERTED GAS BURNERS (*J. G. L.*, Sept. 21).

A new device which is attached to an inverted burner and automatically regulates the admission of air so as to secure the most perfect conditions of combustion.

MEETING OF THE SOCIÉTÈ TECHNIQUE DU GAZ (*Le Moniteur de l'Industrie du Gaz*, Aug. 31; *Electrician*, Sept. 11).

BELEUCHTUNG EINER SPREEINSEL MIT PHAROSLICHT (*J. f. G.*, Aug. 28).

THE BLAND LIGHTING SPECIALTIES (*J. G. L.*, Sept. 21).

L'INDUSTRIE DES BECS À ACETYLENE (*Rev. des Eclairages*, Aug. 15).

L'ECLAIRAGE PUBLIQUE DES GRANDS CAPITALS (*Le Moniteur de l'Industrie du Gaz*, Aug. 31).

LAMPENZYLINDER MIT DRAHTANLAGE (*Z. f. B., A.* Sept. 10)

Contractions used:

E. T. Z. *Elektrotechnische Zeitschrift.*
G. W. *Gas World.*
Illum. Eng., Lond. *Illuminating Engineer (London).*
J. G. L. *Journal of Gaslighting.*
J. f. G. *Journal für Gasbeleuchtung und Wasserversorgung.*
Z. f. B. *Zeitschrift für Beleuchtungswesen.*

The Illuminating Engineer

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LIGHT AND INDUSTRY

"The night cometh when no man can work."

The Scriptural statement expressed a simple fact which held true until science had produced the modern light-source. But in this, as in almost the entire scheme of human life, science has set at naught the truths of the past. The going down of the sun is no longer the signal for the cessation of human industry. There is not an occupation that cannot be pursued under modern artificial illumination as effectively as by daylight.

It is a striking proof of the beneficence of scientific progress that the removal of this limitation to labor has not been accompanied by a lengthening of the hours of the individual laborer, but has increased the opportunities of employment to laborers collectively, thus distributing the benefits of employment to a greater number.

The wise old maxim which divided the day into eight hours of work, eight hours of recreation and eight hours of sleep has been made possible to a much greater extent by the advent of modern illumination; for not only have the actual hours of labor been reduced with the abolition of night, but the hours for recreation have been made available, no matter from what particular portion of the day they may be taken. Whether we work or play, modern illumination has added to our resources.

It is a wonderful testimony to the achievements of science that it has equaled nature in so great a thing as light. The statement that artificial light can be produced which is the equivalent of daylight in every respect is as yet but little comprehended; and yet such is a fact. To carry on any industry under poor artificial lighting is as contrary to the dictates of both humanity and economy as the ancient demand of the Egyptian rulers that their slaves make bricks without straw.

Light is the first of all necessities. Life itself of all forms would cease to exist in darkness. It is not only a necessity for the maintenance of life and health, but is actively destructive to the causes of disease.

Whether considered from the most selfish and utilitarian view as a condition for the efficient operation of the human machine, or from the highest altruistic plane as a natural inheritance of mankind, good lighting is essential. Darkness is ignorance; light is knowledge and skill. From this fact there is no escape; and in the long run it is knowledge and skill that rules the world.

LET US HAVE MORE LIGHT!

E. L. Elliott.

Industrial Lighting

The Most Important Field for the Application of Illuminating Engineering at the Present Time

The field of industrial lighting is confined within boundary lines that are more rigidly defined than is common in the divisions of science. Wherever manual labor is done the illumination furnished for carrying on this labor is properly classed as industrial lighting. Since not only civilization, but the very existence of the human race itself, depends upon labor, and as labor is impossible without the use of light, the importance of the subject of industrial lighting is manifest. It is true that the human race could exist under a high degree of civilization without the use of artificial light, but the present conditions of our civilization are such that a very considerable portion of all the labor performed is done under artificial illumination, and this amount is constantly increasing.

COST OF LIGHT COMPARED WITH THE VALUE OF MANUFACTURED PRODUCTS.

The entire list of industries may be divided for our purpose into two classes—agriculture, or those which deal directly with the products of the soil, in one class, and all other industries in the other. The comparative importance of these two classes may be judged in a measure by the estimated value of the results. According to the latest census reports the total value of the products of agriculture in this country for the year 1899 was $4,717,069,973, and the total value of all manufactured products $13,700,000,000. In the agricultural class the amount of work done under artificial light is very little, although it is worth mentioning that the electric light has been put into practical use in some cases in the large wheat fields of the West to enable harvesting to be done by night as well as by day. This, however, is rather an interesting incident than an indication of any large use of artificial light for agricultural purposes in the future. It is in the other field of industries that the subject of artificial lighting is of vital importance.

It is customary, at least in this country, to consider questions first from the economical or financial viewpoint, and such a view of industrial lighting will at least give us some instructive figures. Let us assume, as a mere guess, but probably a conservative one, that 5 per cent. of all labor in this field of industry is performed by artificial light. Then the value of the products so turned out is $685,000,000. Now suppose that the efficiency of the laborer is reduced 10 per cent. while working under artificial light. This would represent a reduction of $68,500,000 in the output. The total wages paid for manufacturing in the year 1899 is given as $2,323,000,000. On the same basis of estimate the loss in wages to the manufacturers by reason of the reduced efficiency due to artificial light would amount to $11,615,000. From the most recent compilations of the census bureau the total amount expended for gas for lighting purposes is $60,000,000 a year. It, therefore, appears that the probable loss to industry owing to artificial lighting is equal to the gas bill of the entire country. The amount paid for electric light is in round numbers $150,000,000 a year, so that the loss amounts to a third of the total gas and electric light bill.

From the economical point of view, therefore, the question of improving industrial lighting is one which certainly offers an attractive field for the work of the illuminating engineer.

The preponderating value of labor in the total cost of any manufactured article is a fairly familiar fact. In the last analysis we find that labor alone gives value to matter. A diamond in the bottom of the sea is of no more value than the ooze in which it is embedded. It follows that the efficiency of the workman is of first importance in the matter of cost of pro-

duction. Although this fact is by no means neglected, it is frequently not given the attention which its importance demands. This is due largely to the fact that the smaller differences in the efficiency of the human machine are less apparent than in the case of purely mechanical devices, and also that the conditions affecting human efficiency are of far greater range and less perfectly understood.

QUANTITY OF OUTPUT AS EFFECTED BY ILLUMINATION.

If one particular machine turns out a certain number of pieces of work in a given time and with a given amount of power and attendance, and another machine turns out even 1 per cent. more under the same conditions, the results are apparent and measurable, and it is a perfectly simple matter to figure the cost of the machine, the cost of its up-keep and so determine whether the expense of changing for a more efficient one would be a profitable investment. If such a calculation showed that the investment would produce a fair rate of earnings there is no competent manager who would not make the change.

With the human machine such calculation is evidently far more difficult. In the first place, it is a hard matter to determine when the maximum efficiency of any individual has been attained; and in the second place it is equally difficult to determine precisely the variation in efficiency due to causes which are under control. The difficulty of the problem furnishes all the more reason for its careful study. Let it be proven, however, that the efficiency—in other words, the output of a workman—could be increased 1 per cent. by furnishing a better tool, or better conditions, such as better illumination, and it is then a simple matter to determine whether providing such improved facilities or conditions would be a profitable investment.

In the case of artificial lighting there is no doubt as to the result. For example, let us take the case of an average artisan, receiving, say, $3 per day. One per cent. of this amount is three cents. Let us take the power cost of producing electric current as one cent per kilowatt hour, which is all that needs to be figured in a manufacturing establishment having its own generating plant. The three cents will then cover the cost of three kilowatt hours of current, which would supply 375 watts for an entire eight-hour day. Three hundred and seventy-five watts of current will operate one miniature arc lamp or one mercury vapor lamp, or six 50 candle-power tungsten lamps or six 16-candle-power carbon filament lamps. Allowing for maintenance cost of the lamps, we see that 1 per cent. of the wages alone is five times the cost of all the light a workman could possibly use for the entire eight hours of the day.

But the 1 per cent. here figured is on the wages of the workman. The value of his output must exceed this by an amount sufficient to cover the proportionate fixed charge, and the amount representing the profit. If under normal conditions the workman is creating a profit for his employer, then since fixed charges would remain constant, an increase of 1 per cent. in his efficiency, *i. e.,* in the amount of his output, would represent clear profit, less the cost of material.

These figures are sufficient to show that the cost of artificial lighting is simply a negligible quantity as compared with the cost of labor and the value of the laborer's output. One per cent. has been taken as a basis for this calculation simply to show how trivial the cost of illumination is compared with the cost of labor and the value of output. Although exact figures on the subject are exceedingly scarce, in the few instances where records have been kept it has been found that the increase in output during the hours when artificial light is used may be increased as much as 20 per cent. by giving proper illumination; but an increase of 5 per cent. would be a large item in the profit and loss account, since it would represent almost entirely clear profit.

EFFECT OF ILLUMINATION ON QUALITY OF OUTPUT.

Another result of insufficient or improper lighting which must be taken into account is deterioration in *quality* of output. A workman who had defective eyesight would certainly be considered of less value than one with perfect vision, and in many

cases would not be considered at all as a laborer. Such a one might very readily spoil more material than the value of his work. Improper or insufficient illumination is the exact equivalent of defective eyesight. At the best it compels the laborer to work more slowly, and at the worst entails mistakes which may many times exceed the total results of his labor. A mean between these two extremes is a reduced output of inferior quality. A certain large textile mill, which recently remodeled its lighting installation in accordance with the best practices of illuminating engineering found that not only was the output increased from 10 per cent. to 15 per cent., but that mistakes were so few that excuses for imperfect work on the ground that they could not see properly were no longer accepted, and the operatives were held to the same account for the quality of their output during the hours when artificial light was used as during the daylit portion of the day.

EFFICIENCY OF THE HUMAN MACHINE.

The human machine is subject to variation in efficiency from one cause which has no counterpart in the case of the inanimate machine, and that is the general condition of the mind. The mental state, entirely apart from natural intelligence or acquired skill or bodily strength, may reduce the working efficiency of the individual within any limits down to zero. Sufficient mental stress may render work, at least of certain kinds, impossible or valueless. To keep the laborer in a cheerful state of mind is, therefore, just as important a matter from the strictly business standpoint and, considering him only as a machine, as it is to keep the other machinery properly oiled, or the boiler free from scale. It is a perfectly familiar and well established fact that light has a powerful influence upon the mental state. Not only does the amount of light, but its distribution and color have influence in this respect. Broad daylight expresses the highest degree of stimulation of a cheerful kind. Statistics show that the proportion of suicides is very much larger in dark and stormy weather than when the skies are clear. A factory or shop in which there is perpetual gloom must of necessity have its psychological effect in lowering the spirits of those within, with a consequent reduction in their efficiency as laborers.

In the short days now at hand, when the daylight begins to fade early in the afternoon, and is succeeded by artificial illumination, there is generally a falling off in the output of labor in proportion to the difference between daylight and the artificial light furnished. This has been so long the case that it is generally accepted as a matter of course, with no more thought of changing it than of lengthening the day. Modern light-sources, however, and modern methods of illumination render this condition as needless as leaving a workroom without artificial heat in cold weather. As strong an inspiration to cheerfulness, though possibly of a somewhat different psychological character, can be given to artificial light as by sunlight, and the factory manager who fails to provide such illumination wherever possible is simply wasting the resources of his principals.

ILLUMINATION FROM THE HUMANITARIAN STANDPOINT.

Leaving now the strictly commercial view of the question, let us consider it from the humanitarian standpoint. If every employer was of a sufficiently high order of intelligence to understand that it is as important to take care of the laborer as of the machine by which he labors, and that all that the most ardent humanitarian demands is in reality a profitable investment, there would be no occasion for any outside interference or suggestion; but unhappily this is not always the case, and therefore the government, which is seeking always the greatest good to the greatest number, has found it necessary to exercise its authority for the protection and betterment of the laborer. It has been found necessary to provide by legislation for the inspection of factories and workrooms to the end that conditions prejudicial to the health of the workers may be removed. Thus far artificial lighting has received little or no attention, and yet it is one of the most important of the conditions. This should be included in the inspection, and where found inadequate or dangerous to the eyes should be ordered changed with as full authority as would any other unsanitary condition.

FIG. I.—NIGHT ILLUMINATION RAILWAY YARDS, GOERLITZER DEPOT, BERLIN.

German Practice in the Lighting of Railway Stations and Yards

While little is heard of illuminating engineering, by title, in Germany, much is heard of the progress shown in matters of illumination, especially in public lighting. Inasmuch as all of the recent improvements in light-sources had their origin in the "fatherland," the methods of their use in the land of their birth cannot be without interest to American engineers.

The flaming arc was developed to a commercial stage several years before it even appeared publicly in this country, and, as might be expected, has come into much more general use. For large open spaces, and particularly for railway yards, where a smoky condition of the atmosphere generally prevails, the flaming arc is undoubtedly without a rival at the present time. Its high efficiency and large flux of light of an amber color, together with its practical freedom from glare, gives it advantages for such purposes which no other light-source possesses.

Fig. 1 is a view of the yards of the Goerlitzer Depot in Berlin, which is considered one of the best lighted stations in Germany. The illumination is secured by 20 Blondel flaming arc lamps, supported on neat iron poles 12 meters (39.37 ft.) high.

Fig. 2 is a view looking from the yards into the train shed. It will be noted that the illumination brings out clearly all the details, even in the distance, which shows that an engineer running into the shed would have a perfectly visible tract before him.

Fig. 3 shows the train shed of the Friedrichstrasse station in Berlin, which is lighted with twelve flaming arcs of 3000 candle-power, and 12 ampere capacity. They are placed at a height of 9 meters (29.53 ft.).

The enclosed arc, which never came into wide use in Europe, has been select-

FIG. 2.—VIEW OF TRAIN ENTRANCE FROM YARDS, SHOWING YARD ILLUMINATION.

F[illegible] 3.—FRIEDERICHSTRASSE STATION, BERLIN

FIG. 4.—TYPICAL STATION ILLUMINATION, BERLIN SUBWAY.

ed by the engineers as the most suitable luminant for the stations of the Berlin subway. A typical station is shown in Fig. 4. Lamps of this type are also used in the baggage rooms and other rooms having low ceilings in the railway stations. The view shown in Fig. 4 certainly presents a marked contrast in illumination to the dingy and gloomy stations of our own subway, the lighting of which was given a great deal of thought by the engineer in charge, with the assistance of a self-styled illuminating engineer.

While it does not follow from this that enclosed arcs are better lighting units for such purposes than incandescent lamps, it must be admitted that the Germans have accomplished a very desirable end, viz., giving ample illumination to the platforms.

Street Lighting at Norfolk

By R. E. Scott.

That Norfolk is wideawake to the advantages to be derived from an abundance of artificial light throughout the business section is clearly demonstrated by the fact that her progressive merchants and business men are spending large sums of money to make of the downtown section one continuous "great white way." This is being accomplished by them in two ways: by raising the standard of illumination by use of the new high efficiency lamps, both on the inside of their stores and in the display windows—which latter are left burning till late in the evening—and by an ornamental lighting of the streets.

Several months back, upon the request of the merchants, the illuminating engineering department of the Norfolk and Portsmouth Traction Company submitted several designs for ornamental street lighting, and the following scheme was accepted and immediately carried into effect: flat steel arches with a span of 40

FIG. 1.—NIGHT ILLUMINATION GRANBY STREET, NORFOLK, VA.

ft., a width of 12 in. and a rise of 4 ft., were placed across the street attached to the iron railway poles, located every 100 ft. The arches were made up of two 2 x 3-in. angles, rolled to the proper radius and laced together. A ½-in. steel cable was run over the arch from top to top of supporting poles, and messengers dropped to the arch to take care of wind strains. Ten series incandescent center-span suspension outfits were attached to a ½-in. steel cable run 12 in. above top of the arch, and supported by I bolts fixed to the lacing. The lamps are thus protected from violent shocks, making the whole structure as rigid as necessary. The lamps and reflectors alone hang below the arch, and the whole presents an attractive appearance in the day time.

Twenty-seven such arches were placed on Granby street, between Main and Bute streets, each arch having 10 60 candle-power, 75 watt, 6.6 ampere street series tungsten lamps, with automatic cutouts and radial wave reflectors. These lights were turned on at 8 P. M. September 1st, and since that time 20 similar arches have been erected on Main street, between Granby and Church streets, and plans have been drawn for 30 more for Church street.

The Norfolk and Portsmouth Traction Company allowed the use of the iron railway poles, and agreed to act as agent for the merchants in having the work done; did all wiring of arches, running of underground cables and hanging of lamps at its own expense, and further agreed to furnish power for and maintain the system at the rate of $30 per arch for the first year, $70 for the second year and $60 for the third.

The arches were built and erected by a local concern for $50 each, exclusive of the electrical equipment.

The illustrations will give an idea as to the appearance of the streets both day and night.

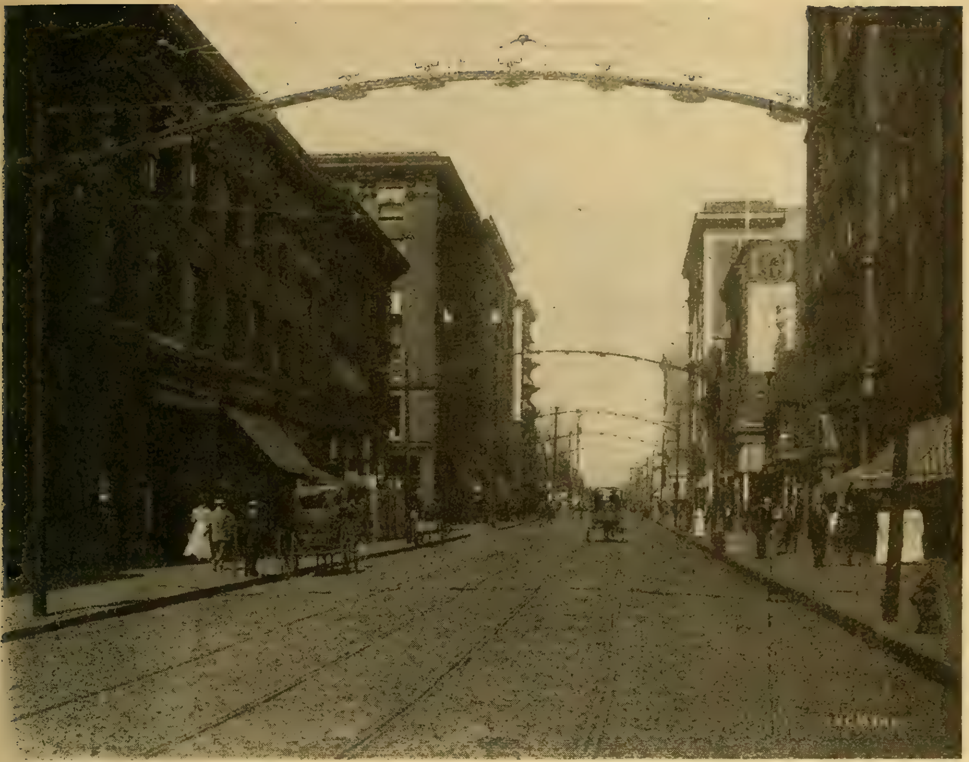


FIG. 2.—GRANBY STREET, NORFOLK, VA., SHOWING ARCHES BY DAYLIGHT.

FIG. 3.—ANOTHER VIEW, SHOWING PERSPECTIVE FROM THE MIDDLE OF THE STREET.

Electric Lighting of Automobiles

By Roscoe E. Scott.

(Concluded.)

The strength of the anchored-back tungsten filament as used for headlight and other automobile service has already been referred to. By way of illustration, a test which was made on such a filament may be of interest. The lamp tested was a new 8 candle power, 6 volt headlight lamp in a round bulb. It was tested by dropping it on to a smooth oak board, laid on a solid foundation. The procedure was as follows:

Starting at a height of ½ in., the lamp was allowed to fall six times on to the board, being dropped first, base downward; second, horizontally; third, base downward, and so on, alternately for six times. This process was repeated at heights of 1 in., 1½ in., 2 in., etc., by steps of ½ in., the lamp standing the test perfectly up to and including a hight of 10 in. above the oak board. A drop of 10 in. in a horizontal position subjects the lamp to a jar many hundred per cent. great than the same lamp would ever be subjected to (barring actual smash-ups) in the roughest touring car service, with the shock-absorbing devices now in use. It may be of interest to note that none of the tungsten multiple types of lamp which are regularly used for residence lighting could stand a drop of 10 in. on to solid oak without having the filament shattered to bits. Tungsten filaments are, of course, plastic when lighted, so that a cold test furnishes the only true criterion.

The headlights have two principal functions; first, to warn persons and animals of the approach of the machine; second, to light up the pathway, thus enabling the chauffeur to avoid obstacles.

The first of these functions demands sharp definition of the beam of light and a high brilliancy, both of which are found to a much greater degree with the tungsten than with the carbon light. Indeed, tungsten is rivalled in respect to these qualities only by acetylene. The second function demands plenty of actual light-flux, which may be obtained at a much higher efficiency with the tungsten than with the carbon lamp.

Coming to the sidelights, these also have two principal functions; first, as ornaments or markers to the machine, without which it would not look complete; second, to throw a certain amount of general illumination about the machine, this illumination being particularly useful when parties are entering or leaving, and when the machine is running "on its sidelights,"—*i. e.,* with its headlights out.

The first of these functions need not be discussed in detail, as the problem involved is principally that of so choosing the fixture that its general appearance will harmonize with that of the car body. As to the second function, it may be said that an extremely high candle power lamp in a sidelight is worse than useless, as it dazzles rather than assists those who are entering the car, and, moreover, spoils the effect of the machine as seen from the side. Photometric tests on sidelights would be of little value, on account of the relatively small importance of these units from a lighting standpoint. One or two minor points which are worthy of consideration when one is choosing a sidelight may be mentioned. It is a good plan to have a small red or green tell-tale window in the back part of the fixture, which will inform the driver in case the lamp burns out or works loose. In general, it is well to have clear glass windows in both the front and outer sides of these fixtures, as indicated in Fig. 8, so as not to waste any more light than necessary by absorption and multiple reflection.

The tail light seems to be considered by many machine owners as more or less of a joke. Any one who will walk along a sparsely-lighted city street on a dark night cannot help noticing that the vast majority of tail lights, owing to low candle power, poor design or location, do not

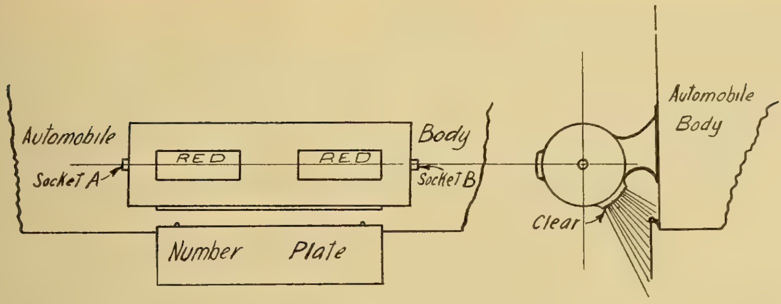


FIG 14.

half serve their ostensible function of illuminating the number plate. Besides this function the tail light has another, viz., to provide a signal to vehicles approaching from the rear. This is ordinarily accomplished satisfactorily by a red glass window in the fixture.

Fig. 14 shows in outline a special style of tail light fixture which was designed by a prominent touring car company, and is intended to really illuminate the number plate of the machine. This it does in a very satisfactory manner, except perhaps to the incorrigible scorcher, who quite naturally prefers to "live in darkness and the shadow of death."

D.—Electrical Equipment.—The apparatus necessary to operate automobile electric lamps consists of the storage battery or magneto generating equipment, switches, wiring, etc.

When six volt tungsten lamps are used it has been found good practice to use at least No. 12 B. & S. wiring, in order to avoid excessive voltage drop.

The simple storage battery system would be satisfactory, were it not for the fact that the cells have to be charged rather frequently if much touring is done at night. For example, a car with the 35-watt equipment of tungsten lamps indicated in table No. 4 could be lighted continuously for about 17 hours on a three-cell battery of 100 ampere-hour capacity before it would need to be recharged, providing the three-cell battery were used only for lighting.

The simple battery system has now been supplemented for engine-driven vehicles by a combined magneto and battery system, which is designed to prolong the discharge period of the battery by from 300 to 500 per cent. The main features of such a system are shown in Fig. 15.* The method of operation is as follows:

When the car is standing still the sidelights and tail light may be run from the storage battery. When the car is started the battery switch may be turned off and the magneto generator switch turned on. The magneto will now generate cur-

* I am indebted to the K-W Ignition Co., of Cleveland, for permission to describe this system.

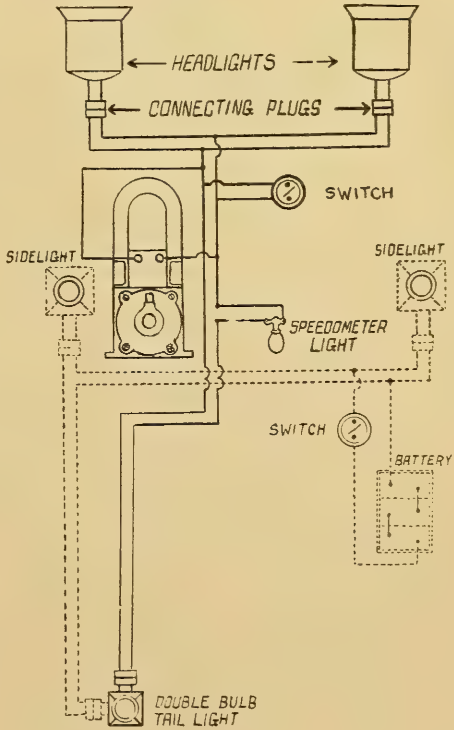


FIG 15.

rent for the headlight and also for the tail light in series with the meter light—the energy being supplied by the engine. If the tail light goes out while the car is running the occurrence is at once detected by the extinction of the meter light. The magneto system has been so fully perfected as to deliver a substantially constant current to the lamps at all running speeds above 12 miles per hour. At lower speeds somewhat less light is given, and, of course, less is needed. Owing to its peculiarly shaped curve of external resistance vs. e. m. f., the magneto used in this system actually takes less energy on short circuit than it consumes in losses on open circuit; this explains why a short-circuiting switch is used, as shown in Fig. 15.

The following cost comparison of two typical installations may be of interest (see table 4):

It will be noted that the tungsten equipment in table No. 4 appears to cost slightly more than the carbon. However, a very important point to notice in the table is that the tungsten equipment consumes only 5 watts, as against 15.2 watts for the carbon, and therefore discharges a given number of cells only about one-third as fast. Moreover, the tungsten equipment *requires* only three cells in series, whereas the carbon requires as many as ten cells in series for the lowest voltage carbon automobile lamps commercially supplied. The economical magneto system of lighting above described has been developed only for tungsten lamps.

The following general conclusions are based upon this investigation of the electric lighting of automobiles:

(1) Electric lighting is an ideal form of illumination for motor vehicles, owing to its brilliancy, convenience and safety.

(2) In order to be a success for touring car work as well as for light runabout work, the electric lamp used must be able to withstand severe shocks to the machine without injury. This desideratum is realized in the anchored-back tungsten filament.

(3) For satisfactory illumination results in automobile lighting, scientifically designed reflecting devices and fixtures should be used. Well developed lines of such devices are now commercially available.

(4) The tungsten automobile lamp is markedly superior to the carbon in nearly all cases, on account of the increased light of superior quality which it gives for a reduced lighting battery capacity.

TABLE 4.

Cost Comparison of Two Automobile Lighting Equipments. (Simple Battery System.)

A.—A *Carbon* installation, consisting of:

2 headlight lamps, 3.6 W. P. C., 6 C. P., 21.6 watts.
Life, 500 hrs. Present retail price $0.23 each.

2 sidelight lamps, 3.8 W. P. C., 4 C. P., 15.2 watts.
Life, 500 hrs. Present retail price $0.23 each.

1 tail light lamp, 3.8 W. P. C., 4 C. P., 15.2 watts.
Life, 500 hrs. Present retail price $0.23 each.

B.—A *Tungsten* installation, consisting of:

2 headlight lamps, 8 C. P., 10 watts.
Life, 300 hrs. Present retail price, $0.60 each.

2 sidelight lamps, 4 C. P., 5 watts.
Life, 200 hrs. Present retail price, $0.50 each.

1 tail light lamp, 4 C. P., 5 watts.
Life, 200 hrs. Present retail price, $0.50 each.

Cost of delivered power to batteries assumed at 15 cents per kilowatt-hour.
Cost of power and renewals figured for 1,000 hours.

A.—Carbon.

Total candlepower = ... 24
Total watts = ... 88.8

Cost of power, $88.8 \times 1{,}000 \times \frac{.15}{1{,}000} =$ $13.20

Cost of renewals:

$.23 \times \frac{1{,}000}{500} \times 2 =$ .... .92

$.23 \times \frac{1{,}000}{500} \times 2 =$ .... .92

$.23 \times \frac{1{,}000}{500} \times 1 =$ .... .46

Thousand-hour cost for power and renewals = ...$15.50

B.—Tungsten.

Total candlepower = ... 28
Total watts = ... 35

Cost of power, $35 \times 1{,}000 \times \frac{.15}{1{,}000} =$ $5.25

Cost of renewals:

$.60 \times \frac{1{,}000}{300} \times 2 =$ 4.00

$.50 \times \frac{1{,}000}{300} \times 2 =$ 5.00

$.50 \times \frac{1{,}000}{200} \times 1 =$ 2.50

Thousand-hour cost for power and renewals = ...$16.75

FIG. I.—NIGHT ILLUMINATION CHINATOWN, SAN FRANCISCO.

The Illumination During the Portola Celebration in San Francisco

By F. W. Jones.

One of the features of the Portola celebration held in San Francisco October 18 to 23, in commemoration of the landing of the first Spanish governor of California—Don Gasper de Portola—and also in honor of the city's recovery from the earthquake and fire of 1906, was the electrical illumination of the streets and buildings. Nothing to equal it had ever been attempted on the Pacific Coast—not even at the Alaska-Yukon-Pacific Exposition in Seattle. It is asserted that more than 30,000,000 candle-power was consumed for each night's illumination. The business streets were light as day, and the reflection could be seen 20 miles distant.

One of the photographs shown, Fig. 1, gives a fair idea of the illumination of Chinatown and the fleet of warships on the bay.

Another, Fig. 2, shows the St. Francis Hotel outlined with incandescent bulbs and with two historical paintings, brilliantly colored with light, on either side of the main entrance. Fig. 3 shows Market street, the business center of the city, with the gigantic electrical bell in the foreground and the brilliantly lighted tower of the Ferry Building in the distance. The structure outlined on the left of the picture is the Chronicle Building. The canopy of lights shown across Market street, extended from the ferry to Van Ness avenue, and comprised 380 strings, placed 20 ft. apart, and carrying a total of 15,580 lamps.

The great bell shown in the foreground was probably the largest bit of single electric display ever attempted on the Pacific Coast. The long strings, gracefully looped, flashed white and green, red and yellow, the whole piece spreading out a luster that reached to the far hills. An occasional slight breeze would swing the lights in easy motion, presenting a rare spectacle to those below. The effect was even more bewildering than its makers had anticipated and demonstrated in a most positive manner the wonderful possibilities of night illumination.

FIG. 2.—ST. FRANCIS HOTEL.

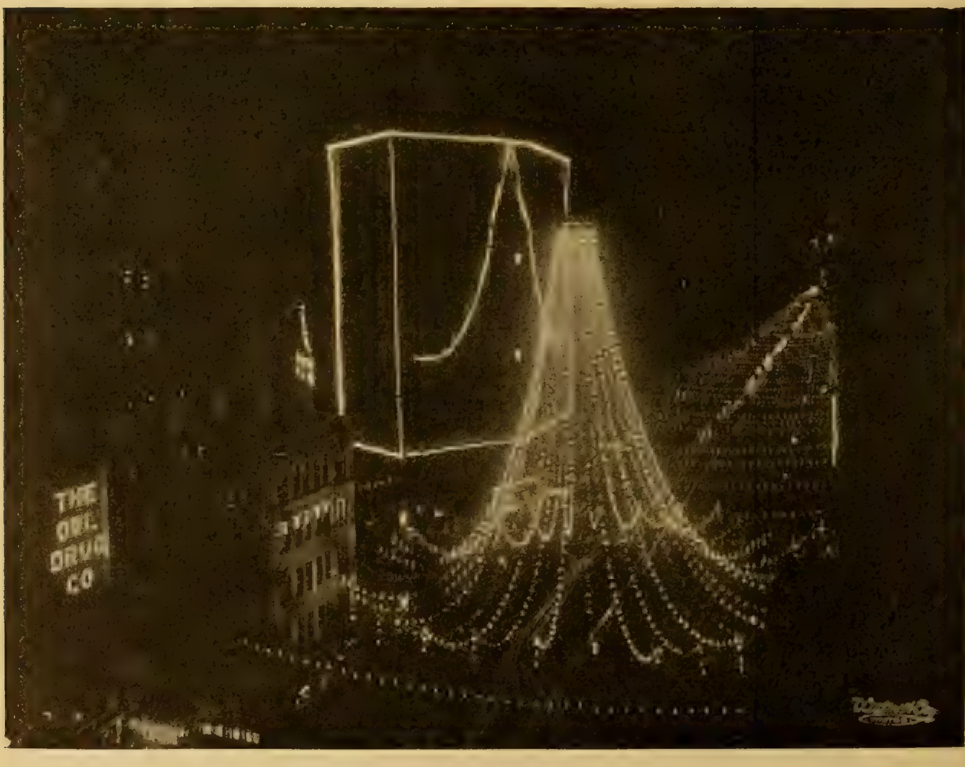


FIG. 3.—MARKET STREET, SHOWING CHRONICLE BUILDING IN BACKGROUND.

Practical Problems in Illuminating Engineering

Incandescent Gas Illumination in An Auction Room

By Norman Macbeth.

"The proof of the pudding is in the eating thereof" and "You have to live with a man to know him" are two adages which, having truth as a basis, have withstood the severe test of time.

In the November, 1908, number of the Illuminating Engineer was described an installation of inverted gas lamps on the second floor gallery of the auction house of Samuel T. Freeman & Co., Philadelphia. This floor was used exclusively for special sales of high grade furniture, fine pictures and libraries, these special sales occurring at such infrequent intervals that it was believed that with an electric installation the greater proportion of the expense would be central station readiness to serve charges and consequently, high current costs.

FIG. 1.—THE AUCTION ROOM.

The firm were rather favorably disposed toward tungsten lamps, having heard the praises of these lamps sounded in several keys by as many rival salesmen, whose particular lamp showed a longer life and radiated more sunlight than any other. An investigation of the conditions, however, failed to show that the engineer who designed and proposed the inverted incandescent gas lamp equipment was acting from any other standpoint than that of this firm's interests.

At that time the first floor, shown in Fig. 1, was illuminated by ten upright four-mantle gas arc lamps with alabaster globes and carbon filament electric incandescent lamps. The latter were regularly spaced in three rows down the ceiling, suspended on drop cords, with accessories representing various ideas in manufacture, from the ordinary glass shades through to flat metal reflectors. The gas arc lamps were irregularly arranged, as shown by symbols on plan, Fig. 2.

The illumination of this floor, the central portion of which is in use practically all day, was far from satisfactory, but was deemed of such importance, both from the standpoint of effective illumination and maintenance cost, that the firm would not consider any further changes until they had fully tested out both the inverted incandescent gas lamps and the new tungsten lamps. The latter were tried in various existing outlets on the first floor and offices, together with a complete installation in the show windows. Attention was paid especially to life and maintenance costs—the electrical costs during this period were 6 cents per kilowatt hour.

After a year's experience with the gas lamps on the second floor, the service and resultant illumination were so satisfactory that the order was given to equip all the first floor, and in addition the offices on the second floor, with the inverted incandescent gas lamps, on fixtures similar to those previously installed, having a cock in the fixture body with a chain pull controlling the lamps on each fixture as a unit. The plans and estimates provided for the taking down of all the upright mantle gas arcs as well as the electric incandescents, and the removal of all wiring from the ceiling.

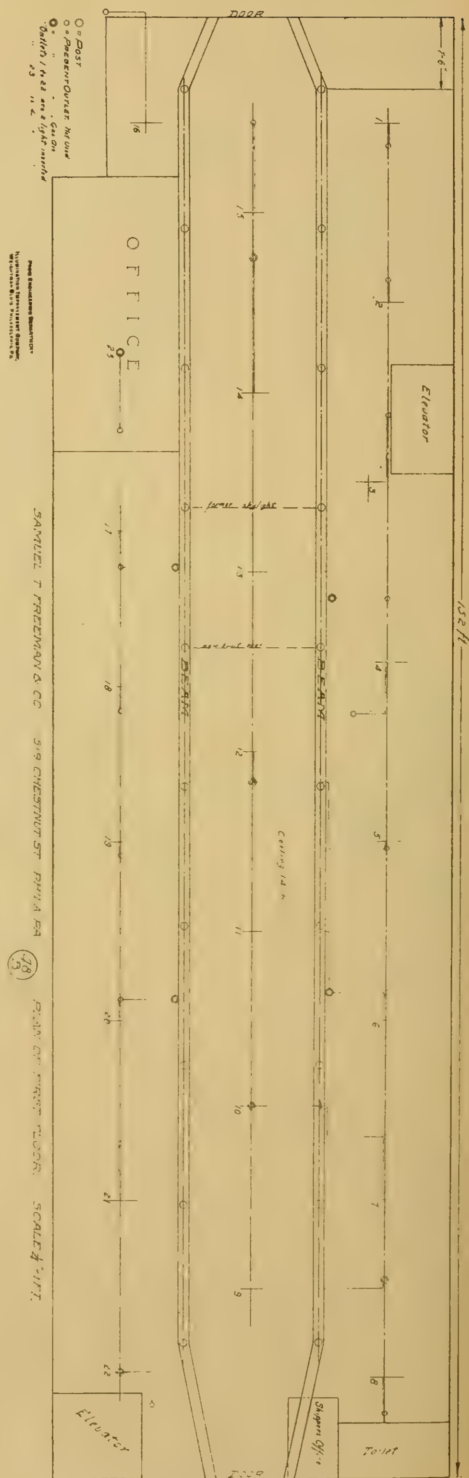


FIG. 2.

It might be here noted that the gas consumption for the highly uniform illumination with the inverted mantle lamps is 20 per cent. less than that required for the inadequate service of the upright mantle arcs used previously, and in addition there is the total saving on the electric current formerly required on this floor.

Of the twenty-three outlets used, extensions were necessary from the regular outlets provided in the original piping of the building for twenty-two—that is, but one outlet on the entire floor was used without change.

The problem was to provide adequate but not brilliant illumination with a uniform distribution, and to secure the appearance of abundance of light by the use of clear cylinders and rather wide opal reflectors. It is extremely important that the goods be shown under the light which will most enhance their value in the eyes of possible purchasers, and that the auctioneer from his elevated stand, at a height where only the opal reflectors are in his line of vision, should be able to clearly see every nod, wink, or gesture from a bidder, that all who wish may have an opportunity to bid on their choice.

This floor is 152 feet by 41 feet 8 inches, with a ceiling height of 14 feet 6 inches, ceiling and walls light. The walls are a light blue calcimine, the actinic value of which was, however, higher than the light painted ceiling, as shown by Fig. 1. For purposes of calculation the walls were considered "dark," as frequently rugs and carpets were displayed, as shown in the left in Fig. 1. Twenty-two two-light fixtures, using the inverted lamp equipped with opal reflector, the distribution of which is shown by Fig. 3, were installed at a height of 12 feet 6 inches to mantle centers above the floor, and at distances of 18 feet between outlets and approximately 14 feet between rows.

The entire installation on both floors is under maintenance by the gas company on a yearly contract, and it was when under regular service conditions that illuminometer measurements were taken. These measurements show a mean of 2.5

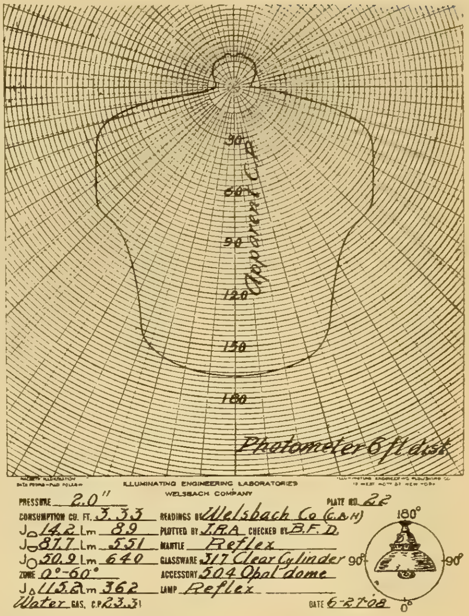


FIG. 3.

foot-candles with a minimum of 1.4, the latter close to the walls midway between side outlets.

A mixed gas is supplied having a calorific value of about 650 B.T.U., and the pressure during the test was 17 tenths.

SUMMARY OF INSTALLATION.

Dimensions of room, 152 feet by 41 feet 8 inches.
Height of ceiling, 14 feet 6 inches.
Height to mantles, 12 feet 6 in.
Height of test plane, 32 inches.
Number of fixtures, 22.
Number of lamps, 44.
Nominal consumption of lamps, cubic feet, 3.3.
Total consumption of lamps, cubic feet, 146.7.
Pressure in tenths, 17.
Mixed gas, calorific value in B.t.u., 650
Effective area of floor space in square feet, 5,600.
Cubic feet of gas per square foot, 0.026.
Average foot-candles on plane, 2.5.
Lumens per cubic foot of gas, 95.24.
Cubic feet of gas per lumen, 0.0104.

The Tailor Shop Problem

By A. L. Eustice.

The article by Mr. R. W. Pierson in the October Illuminating Engineer, entitled "The Lighting of a Tailor Shop," is rather interesting, and it was studied by the writer with considerable surprise and regret that direct comparison was made with the very different solution given in the September number.

To begin with, it is certainly a matter of regret that Mr. Pierson used, as a basis for his solution, figures on Illumination Efficiency of Tungsten Lamps (4 lumens per watt), whose accuracy for some time past has been open to considerable criticism, and which were admitted by the originator of the same at the last convention of the Illuminating Engineering Society to be incorrect and subject to revision.

As a matter of fact, the actual illuminating efficiency of a system employing one type of unit varies considerably in rooms of various dimensions, color and placement of surroundings, and when a system is installed in a shop such as the subject of Mr. Pierson's solution, the actual illuminating efficiency does not equal the theoretical value not only for this reason but also due to losses both in candle power of the lamp employed and in illumination caused by accumulations of dirt on the reflecting glassware.

Although in Mr. Pierson's opinion, 5-ft. candles is a sufficiently high intensity for "a" tailor shop, it will be noted that the value of 6-ft. candles, as recommended by the writer, was employed "in order to make this solution comparable with the Nernst." It is obvious that 6-ft. candles is not excessive in this case when consideration is given to the general dark color of the interior, as well as the goods displayed (also cutting, fitting and sewing dark materials), which figure is considered good practice. (*N. E. L. A. Bulletin No. 7* recommends 4 to 7 ft. candles, with no qualifications regarding color, etc.)

The location of outlets recommended by Mr. Pierson is rather a new departure when the object sought for is to provide the tailor shop with "good illumination," and certainly the outlets are so vastly different from the solution submitted by the writer that any comparisons of cost are of no value, and even further, are decidedly misleading. In the opinion of the writer it does not require the services of an illuminating engineer to substitute electric units for gas in substantially the same location of outlets and, when the five gas arcs formerly provided inadequate illumination for the shop it does not seem probable that 12 100-watt tungsten lamps, even in a layout as suggested, will give the owner any improvement over his gas system.

A close examination of the picture will show that the two gas arcs in front of the shop are located at a considerable distance from the windows, and from the ceiling design it is only reasonable to assume that another gas arc is in the rear of the shop, beyond the range of the camera, and hence were all employed for utility rather than for purposes of display.

From a viewpoint of improved illumination the location of outlets Nos. 1 and 2 are absurd, since they are placed very near the windows, and the flux of light in the direction of the windows is nearly equal to the effective flux in the direction of the room. It is obvious that the flux in the direction of the windows is a waste and requires the remaining units to deliver effective illumination at a higher efficiency than Mr. Pierson assumed for the entire system. The same conditions apply to outlets Nos. 3 and 4, for here the flux of light in the direction of the wall is, for the most part, absorbed, instead of penetrating the window as in the case preceding.

In selecting the location of outlets Nos. 5 and 6 and also determining the number of units (four-light fixture of 100-watt lamps) per outlet, Mr. Pierson evidently did not consider that a high standard of diffusion in shops of this nature is imperative and that it is therefore not only desirable but also essential to employ small units and a distributed system. The nature of the work and the color moreover demand the use of satin finished or enameled prismatic glassware. The interfer-

ence losses in clustered units were not included in the assumed efficiency, and if it were possible to make actual tests of the mean illumination delivered by the system, as shown in the plan, the results would, no doubt, show a surprising drop in the actual value of lumens per watt.

In regard to cost of equipment, even without considering the obvious great difference in illuminating value of the two systems, the statement made by Mr. Pierson that the cost of fixtures for the solution employing tungsten lamps "will be far less than for the solution using Nernst" is, to say the least, unfair to all interests concerned. For the sake of argument, assume that a very neat but cheap pendant is used to suspend the lamps in either system suggested by the two solutions and two four-light fixtures are employed at the center outlets of the tungsten system, the cheapest of which, for pendants and fixtures at all in harmony with the requirements of the shop in question, would cost at least $1.70 each for the former (6-ft. pendant) and $7.50 each for the latter, and the investment figures given by Mr. Pierson become:

TUNGSTEN.

Lamps complete (12)	$23.40
Four 6-ft. pendants at $1.70..........	6.80
Two four-light fixtures at $7.50......	15.00
Total cost of equipment........	$45.20

WESTINGHOUSE NERNST.

Lamps complete (11) at $3.375.......	$37.13
Eleven 3-ft. pendants at $1.10........	12.10
Total cost of equipment........	$49.23

From this it is to be noted that, instead of a difference in cost of $13.73, as quoted in favor of the tungsten system, the true difference in costs of the equipment where the Nernst units are sold at the consumers' minimum discount (sales less than $250) is only $4.03, which is outweighed many times by the difference in the quality of illumination produced by the Nernst system—that is, a distributed versus a concentrated system.

However, in view of the fact that Mr. Pierson based the first cost of the tungsten system on central station prices to consumers, which is lower than the regular market price, it is obvious that for comparative figures the first cost of the Nernst system should be established on the same basis and the price used for which the lamps are sold to the consumer by the central station, according to the schedule of prices now maintained by most large lighting companies for the sale of Nernst lamps by the central station, which schedule fixes the selling price of the 132 watt single glower lamp at $2.25 net.

On this basis the above tabulated costs remain unchanged in the case of the tungsten system, whereas in the case of the Nernst system the costs become:

Lamps complete at $2.25 net..........	$24.75
Eleven pendants (3 ft.) at $1.10......	12.10
Total cost of equipment........	$36.85

which shows a reversal of total first costs and the difference of $8.35 in favor of the Nernst system.

While the writer would not recommend, under any circumstances, the location of outlets advised by Mr. Pierson in this shop where the predominating tone is dark, but assuming the spotty and undesirable illumination effects would be tolerated by the owner of the shop, and in order to place the two systems on further equality in so far as the number of outlets and wiring expense is concerned, the concluding figures herewith given are on the basis of employing a Westinghouse Nernst system (of suitable size units) with approximately equal total energy consumption located at the outlets as specified by Mr. Pierson and criticised by the writer. Exhaustive tests have demonstrated that such a Nernst system would provide a mean illumination equal to the tungsten system as outlined and, with the use of 110 watt Nernst at outlets Nos. 1 to 4 and the three-glower unit (396 watts) at outlets Nos. 5 and 6 as the basis, the following figures are in order:

FIRST COST—TUNGSTEN SYSTEM.

Lamps complete (12)................	$23.40
Four 6-ft. pendants at $1.70..........	6.80
Two four-light fixtures at $7.50......	15.00
Total cost of equipment........	$45.20

NERNST SYSTEM (CENTRAL STATION RESALE PRICES).

Four 110 watt at $2.25...............	$9.00
Four 6-ft. pendants at $1.70..........	6.80
Two three-glass canopy lamps (complete) at $10......................	20.00
Operating costs per month......	$35.80

TUNGSTEN—CONNECTED LOAD 1.2 K.W.

Current (100 hours per month at $0.10 per kilowatt hour)	$12.00
Maintenance at $0.015 per kilowatt hour	1.80
Total operating cost	$13.80

WESTINGHOUSE NERNST—CONNECTED LOAD (FOUR 110 WATT AND TWO 396 WATT) ONE 232 K.W.

Current (100 hours per month at $0.10 per kilowatt hour)	$12.32
Maintenance at $0.005 per kilowatt hour	.62
Total operating cost	$12.94

Again, the true comparative figures on first cost show the tungsten system to cost $9.40 more than the Nernst, and the total operating costs per month favor the Nernst system by the saving of the sum of $0.86.

A Horrible Example

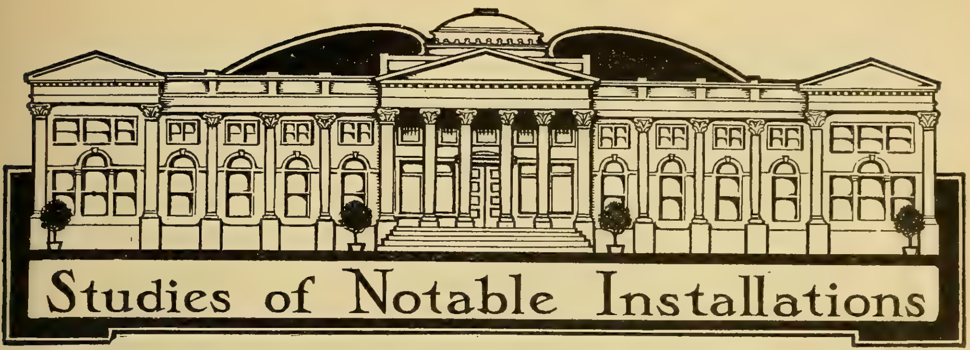
By Arthur L. Rice.

One of the best examples of how not to do it, in arranging the lighting of a building, is now in operation at the Coliseum Garden in Chicago. The cardinal principle of good illumination is that there should be an even distribution of light with no insistently bright spots. In the arrangement of the Coliseum lighting the overhead trusses are hidden by a black cloth which represents the canopy of night, and through this shine a miscellaneous collection of incandescents representing the "starry firmament on high."

At one end there is one of the Tyrolean Alps which has become separated from its relatives and has a golden tinge of sunset cast upon it by light shining through a rift in the nocturnal canopy. Below stairs there is no lighting except from tissue-covered globes representing various edible fruits of tremendous size which decorate the porch boxes around the sides of the room.

So far there is nothing to be criticised, but to spoil the entire effect and to torment suffering humanity, at about 8 ft. above the gallery rail an intensely bright line of incandescent lamps, placed about a foot apart and with reflectors on top which throw the light downward into the eyes of those on the floor and especially into the eyes of those sitting in the gallery, runs entirely around the immense room. The strain on the eyes in endeavoring to see anything in the murky dusk while the eyes are closed to protect themselves against this brilliant line of light is so severe that the after-effect lasts for two or three days. Certainly no one can sit for an evening in one of the gallery seats without suffering for a week afterward and probably doing a permanent injury to the eyes.

Why such a scheme as this should have been adopted with the present enlightenment with regard to correct principles of illumination, particularly by people who have had so much to do with fine lighting effects as those who handle the Coliseum, is one of the mysteries of engineering.



Church Lighting

I.

Of all lighting problems the church unquestionably offers the most difficult. The difficulties arise from a variety of sources. First and foremost of these is the architecture. In the present practical age the church stands almost alone as a type of building in which architecture, in the highest meaning of the term—*i. e.,* as an expression of art in building—is paramount. For this reason alone the formulæ of the illuminating engineer, which are quite sufficient for guidance in laying out a system of illumination for a building of primarily utilitarian purpose, are wholly secondary when it comes to the illumination of a church. Aside from the lighting being entirely dominated by the architecture, the type which represents by far the larger majority of churches is of such character as to afford special difficulties in the way of artificial illumination. Gothic architecture, by reason of its association with religion, has been reserved almost inviolate for the construction of the sacred edifice. The most familiar and characteristic features of this type are the pointed arch, the high, pointed roof, left with its construction showing from the interior, and the vistas produced by parallel rows of columns, arches, and roof trusses. Whether or not the original conception was suggested by nature, these elements produce something of the majesty and awe that is produced by the forest of primeval trees, whose trunks reach a towering height and whose branches meet in shadow far above the head. The solemn beauty of the forest is enhanced by the deep shadows relieved only by occasional shafts of sunlight falling through openings among the boughs. He would be a bold illuminating engineer indeed who would undertake to preserve a moiety of this grandeur by any means of artificial lighting at present within his reach. To attempt this by hanging up incandescent electric lamps would be only to bring into ludicrous prominence the utter inability of man to cope with the art of nature; and to use the more powerful sources, like the arc, would be like attempting to simulate the murmur of winds through the leaves by blowing blasts on a fog-horn.

These same conditions, to a lesser extent, apply to the lighting of a Gothic church. Visible light-sources are an intrusion, no matter where placed, and indirect lighting is generally impracticable. Perhaps it is best to admit at the outset that there has been no wholly satisfactory method of artificially lighting an edifice of this character. Our efforts can then be directed to reducing the faults and objections to their lowest terms. The recognition of the difficulties of the problem could not be made plainer than by the fact that, of a dozen photographs of church interiors taken at random, no two showed the same system of illumination.

The Gothic church has come to us unchanged, except to be dwarfed in size and often degraded in general execution, since its earliest development in a time centuries before our modern methods of

FIG. I.—ST. PATRICK'S CATHEDRAL, NEW YORK.

lighting were even dreamed of. The problem of lighting it with these sources is somewhat as if we were required to clothe the Hermes in a dress suit, or put stays on the Venus of Milo. Since no one has succeeded in solving the problem, no hesitation need be felt in pointing out all of the faults of any installation.

We may as well begin at the top and take a church of cathedral rank, and one which may reasonably be supposed to represent Gothic architecture in America,—St. Patrick's Cathedral, Fifth Avenue, New York. A view of the nave is shown in Fig. 1. The lighting fixtures are hardly discernible in the engraving. They consist of the simplest possible form of gas chandelier suspended from the arches and near the roof. These consist of three concentric circles of gas pipe thickly studded with flame gas jets. This was apparently the original provision for artificial lighting, which has been supplemented at a later date by the addition of cluster electric lights attached to the columns a short distance above their bases. These electric lamps are left entirely bare. Architecturally these brackets are glaring excrescences upon the magnificent columns. From the illuminating engineer's standpoint the glare of the bare incandescent lamps, unavoidably in the line of vision.

is exceedingly bad. In the original installation no attempt whatever was made to have the lighting fixtures partake of a decorative nature, but rather to keep them as inconspicuous as possible, which, all things considered, offered the least of the evils. It is hardly possible that as lighting units, however, they could have produced anywhere near even the dim illumination sufficient for the purpose. Neither the old nor the new installations can therefore be called at all satisfactory, to say nothing of their harmony with the surroundings.

Let us now turn to a church of more modest dimensions, but in which the Gothic features are well preserved. Fig. 2 shows the interior of the church of St. John the Baptist, West Thirtieth Street, New York City. The lighting here is by brackets attached to the sides of the double pillars, each bracket supporting three upright mantle gas burners with diffusing globes. From the illuminating engineering standpoint this method of illumination offers no serious grounds for criticism, though the sources are well in the line of vision. If the globes provided are of sufficiently opalesced glass,—and there is no reason why they should not be,—they would not be particularly objectionable on this account, and the intensity of illumination furnished is doubtless quite sufficient for all purposes. Architecturally, the fixtures in themselves are of suf-

FIG. 2.—CHURCH OF ST. JOHN THE BAPTIST, NEW YORK.

FIG. 3.—ST. ANDREW'S CHURCH, NEW YORK.

ficient size and prominence and of such design as to bear a fairly harmonious relation to the columns to which they are attached. The only point in which this system of illumination fails is that it leaves the upper portion of the church in comparative darkness, whereas under daylight conditions this portion is the lightest, receiving abundant daylight through the windows of the clearstory. Light should, wherever possible, come from above, so far as the esthetic effect is concerned. No matter how brilliantly the illumination on what the engineer calls the "working plane,"—a distance two or three feet above the floor,—if the ceiling of the room is in darkness there is a feeling of gloom; and this must be the case to some extent in this installation.

Fig. 3 is the interior of a church in which the Gothic features are preserved, but of still more modest dimensions. In this case the lighting is provided by electric lamps and gas jets placed around the capitals of the pillars. The electric lamps are left bare, and the gas lighting is by flame burners. This installation offends every principle of illuminating engineering and architecture. From the first point of view, the lamps are unshaded and so

placed that the eye cannot escape encountering a considerable number of them. Architecturally considered, the lamps overhang the decoration of the capitals like a fringe, thus obliterating the detail and breaking the continuity of the construction. It is difficult to conceive a more awkward location for electric lamps. Furthermore, the law, first clearly enunciated, so far as we know, by Mr. C. Howard Walker in his address before the first convention of the Illuminating Engineering Society, that "light represents a void and should never come from supporting structures," is here totally disregarded. The entire upper structure of the church, including the side walls and roof, is supported on these capitals, and to throw a ring of light around these points is to leave this superstructure without support.

Fig. 4 shows the interior of a church in which the Gothic lines are retained, but in which the structure is modified by the omission of the clearstory. In this case the electric lamps have likewise been placed about the capitals of the column, but owing to the structure are considerably higher than in the former example. The criticisms made in the former case, however, will apply here.

Fig. 5 is another church in which the Gothic elements are retained. The lighting problem in this case has been solved in a very much more satisfactory manner by the

FIG. 4.—CHURCH OF THE INCARNATION, NEW YORK.

FIG. 5.—CHURCH OF THE HEAVENLY REST, NEW YORK.

use of chandeliers dropped from the points of the arches. The lamps are left bare, but are apparently frosted,—at least they should be. The design of the chandelier is in good keeping with the architecture. The main body of the chandelier, furthermore, is hung in line with the capitals of the columns, thus offering as little break as possible in the units of the general structure. The individual lamps are left unshaded and are somewhat objectionable, as they are far from decorative in themselves and afford a multiplicity of points of light, thereby distracting the eye to a greater extent than would a single source. As a suggestion, this fault might have been overcome by placing the lamps within a large hemisphere of opalescent glass supported by the ring of the chandelier, and made up in sections. This would, of course, somewhat reduce the efficiency, but that is not a material question in this case.

In all the examples given there is an evident attempt to retain, or at least to interfere as little as possible, with the general air of the sanctuary. Gorgeous lighting fixtures and effects would seem to be as out of place as gaudy and ostentatious dress. (To be continued.)

Fixtures and Accessories

The Lamp as a Motif in Fixture Design

Association is, perhaps, the strongest of the motifs affecting the sentiments. Nothing ever tastes quite so good as the dishes mother used to make, and even the odor of the barnyard may be pleasing to the jaded city dweller, to whom it recalls the golden days of youth. History has no record so old that it does not lament the decadence of the times, and the passage of the good old days. Our memories have a kindly faculty of omitting or glossing over the unpleasant events of youth, and preserving a picture at which we never tire of looking in our later years; and still more rosy-hued is the picture of the times when our fathers and grandfathers were young. Whatever has been in close personal contact with our ancestors acquires through association a significance wholly apart from the thing itself. If we cannot have the actual relics we may preserve at least a portion of their human interest by making more or less faithful copies.

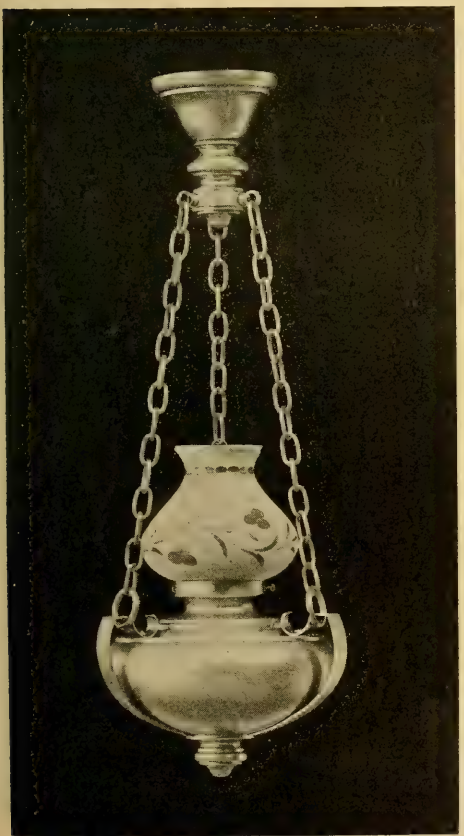


FIG. I.

And so, whatever argument may be advanced against the legitimacy of imitation in decorative art, the power of association and the natural and universal tendency of the human mind to glorify the past, will continue to demand reproductions of the older forms of art. The more intimate the association the more insistent is this demand. Nothing has a more intimate connection with life than those things which are used constantly in the home. Undoubtedly the fireplace is a villainous way of heating a room, from the purely scientific viewpoint; but it still persists in a more or less close imitation of its original and glorious condition, and if any one doubts its superiority over the iron stove, to say nothing of the steam radiator, let him read what Hawthorne has to say on the subject. Likewise, the candle is a poor little make-shift as a light-source, but our fathers and grandfathers used the candle, and their fathers backward time out of mind; and so it happens that more candles are being used to-day than ever before in history; and where the candle itself is im-

FIG. 2.

practicable, imitations, often exceedingly crude, are found in abundance. The oil lamp for precisely similar reasons is an object of veneration to the extent that we are quite willing to conceal the glories of the modern electric lamp in order to preserve a semblance of this ancient light-source.

The popularity of the so-called Colonial architecture has its origin quite as much in association with the golden age of our own country as in its inherent austere beauty. The matter of lighting dwellings of this character with modern light-sources without introducing jarringly discordant elements is a puzzling one, and has often been but poorly solved. Too frequently the efforts have run to carrying out in the lighting fixtures the classical elements of architecture, which form a more or less obscure basis of the Colonial types of structure. This fault arises from a misconception of the character of a lighting fixture with reference to the building, viz., of considering it a part of the structure instead of a part of the furnishing. To preserve the atmosphere of Colonial times not only must the structural features faithfully express the architectural types of those days, but the furnishings, including the lighting fixtures, likewise follow the prevailing taste of the same period. The methods of illumination at that time were oil lamps and candles. The former made use of the glass shade, and for decoration glass prisms and jewels were the common means employed. The lines of the lamp and globe were simple and severe, corresponding to the spirit of the architecture, but were exceedingly well proportioned and pleasing. These lamps furnish a motif which, though having no great pliability, is still adaptable to modern fixture construction, and undoubtedly affords the best solution of the fixture for Colonial dwellings. Single suspension lamps, chandeliers and brackets are designed, using the lamp of Colonial times as the chief feature.

Fig. 1 is a good example of such a fixture simulating a single oil lamp; in fact,

FIG. 3.

FIG. 4.

the fixture might very readily contain an actual modern kerosene lamp. The grace of outline and harmony of proportion is sufficiently apparent to need no comment.

Fig. 2 shows an elaboration of this theme, representing a central bowl with lamps at the sides, as well as one at the top. This is an artistically good simulation, for the reason that the structure could be made real without change in design.

Fig. 3 shows the same general structure, but with the added decoration of glass prisms.

Fig. 4 shows three adaptations of the motif to wall brackets. While the lines of the lamp itself are equally pleasing, the general effect is somewhat marred by the regular canopy and supporting tube by which the bracket is attached to the side wall. While such a construction would not be impossible in the case of an actual oil lamp, it would hardly be probable. A lamp is essentially a movable apparatus, this being almost a necessity for its proper care. In the examples shown the fact that the lamp is permanently attached to its support is evident.

Figs. 5 and 6 show a variety of brackets of the same general type, to which the same criticisms would apply.

It will be observed that the point of support in these is given two different positions—either the center of the bowl or the neck of the lamp. The discrepancy

FIG. 5.

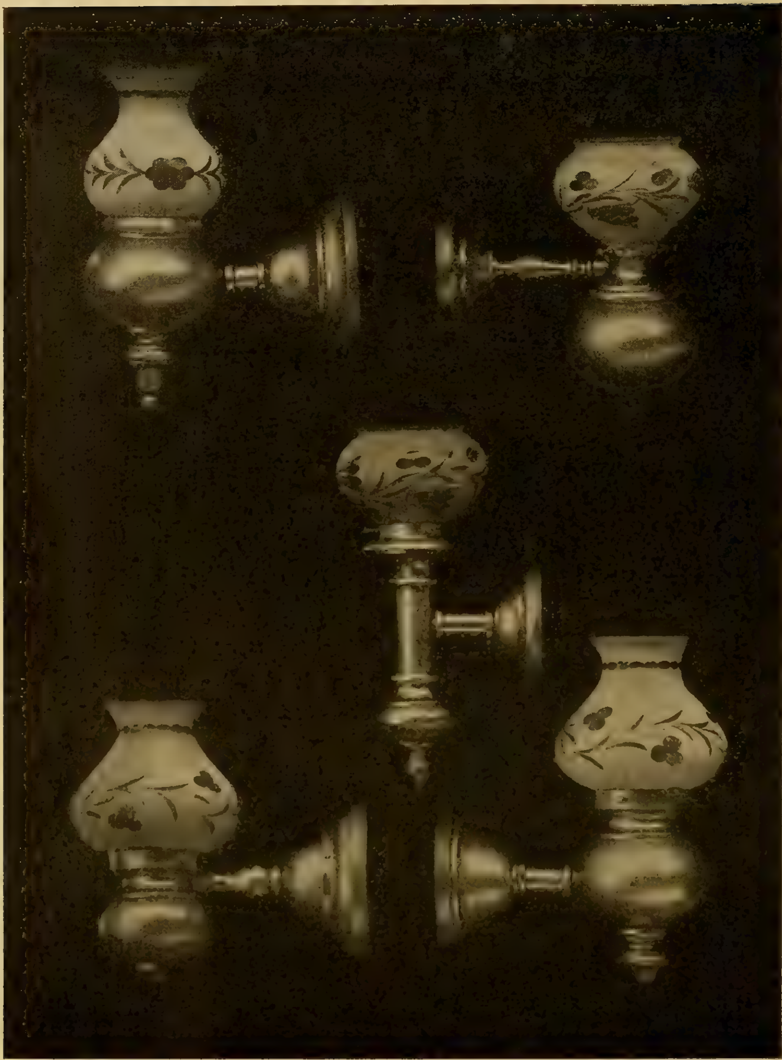


FIG. 6.

of the former method could easily be removed by running a band around the center of the bowl, which would afford an ostensible means of removing the bowl when necessary for refilling. Such a band would in no wise interfere with the lines or general artistic effect of the fixture. The support at the neck of the lamp is less easy to correct.

The central bracket in Fig. 6 is a simulation of the Argand lamp, the lines of which are well carried out, but the ostensible oil supply of which is entirely wanting.

These criticisms may, perhaps, appear fanciful and an unnecessary refinement; but it will be found that where simulation or imitation is used, the closer the resemblance in every detail, the more effective will be the appeal to the artistic imagination. The glass candle equipped with a round electric lamp is simply a burlesque; and the huge metal contrivance in the form of the ancient torch bearing a cluster of these burlesque candles is a travesty in lighting fixtures comparable to Hamlet parading in a football suit.

Theory and Technology

Plain Talks on Illuminating Engineering

By E. L. Elliott.

No. XXIII.

INDUSTRIAL LIGHTING: GENERAL CONSIDERATIONS.

In the general field of industry America stands in the front rank, if not indeed at the very head. Notwithstanding our much higher prevailing rate of wages, which form the principal part of the cost of any manufactured article, we are in a position to successfully compete with older nations, at least in all manufactures which are largely machine made. This is due, by general consent, to the fact that we obtain a higher efficiency, both from men and machines. The systematic study of costs, in which they are analyzed down to the last detail, and the correction or improvement of every detail where improvement is possible is the largest factor in this efficiency, inventive skill being the other principal factor.

The ratio of output to payroll pretty nearly expresses the rate of dividend. It was the recognition of this simple principle more than anything else which gave Carnegie the mastery of the iron and steel industry of this country within the short period of a quarter of a century. While his competitors were satisfied to retain antiquated machinery and methods because they continued to show a profit, Carnegie and his lieutenants worked with almost sleepless vigilance to make improvements; and it mattered not how recently a plant had been put in, nor how great a sum had been expended on it, if better machinery or methods could be devised the plant was remodeled with all possible speed. And so it happened that after a decade of this ceaseless work of improvement and growth all of his strongest competitors combined found that the great iron master completely dominated the situation, for the simple reason that he could sell his product at a profit for less than they could manufacture. The lesson so powerfully taught to the steel industries has been very generally learned by manufacturers in general, viz., *no matter what the present profits may be, if a change in methods or machinery will increase the efficiency of the plant* (by plant the entire aggregation of men and machines being understood), *the change should be made.*

Figuring on this basis at once brings out the fact that it requires but an insignificant percentage of increase in efficiency to justify a change in the plant. The manager of a large textile mill was recently asked, "If you could find a loom which would give you 2 per cent. greater output under the same conditions as your present looms, would you put it in in place of those now in use?" To which he answered promptly, "I most certainly would." It is safe to say that a like percentage of gain in any item of running expense would justify an equal expenditure of money. In the production of power and the generation of electric current and its transmission and use the mechanical and electrical engineers would certainly figure down to a closer percentage than this; and the installation which assured the user of a 2 per cent. gain over other systems would be put in regardless of any prevailing difference in cost.

It is possible to conduct many lines of manufacture so as to show dividends on

the invested capital without keeping an analytic record of costs, just as it is possible for a man to maintain a good degree of general health and strength without systematic physical exercises; but when it comes to the test of endurance, or speed, as in time of industrial depression, then the industry that knows where every cent of its expenditure goes is as sure of winning as is the trained athlete in the contest with the untrained, though perhaps naturally stronger individual.

The three general items of manufacturing cost are: fixed charges, labor and raw materials. The first of these includes all expenditures except the wages of laborers actually engaged in productive work. The term "fixed charges" implies the fact that this item is approximately constant, while the other two items may vary through proportionately wide degrees of difference. There is always a certain "irreducible minimum," beyond which fixed charges cannot be reduced, and the problem of reaching this minimum is comparatively simple. The cost of raw materials is a still more simple problem to reduce to its lowest terms. The question of profits is, therefore, a matter of eternal vigilance in the quantity of output in its relation to fixed charges. It is for this reason that a difference of even 1 per cent. in the efficiency of machinery, or in the generation and utilization of power, is a matter for serious consideration.

It would seem to be an equally obvious fact that improvement in the conditions under which the machines are operated which would show an equal gain in output would be given equally serious consideration. Strangely enough one of the conditions which is absolutely vital is generally given the least attention, viz., the light by which the operator works. The most skilled mechanic and the latest improved machine would be valueless if placed in an absolutely dark room; and between this and the value in a space perfectly lighted all variations between zero and maximum are possible. A considerable portion of this neglect is undoubtedly chargeable to the fact that artificial light-sources and the illumination produced has, until a comparatively recent time, been necessarily so imperfect as compared with daylight conditions that the inferiority has been accepted as a matter of course. Excuses for mistakes and defective workmanship based on the fact that the work was done by artificial light have been considered sufficient, and a falling off in the quantity of the product has been accepted for the same cause without a thought of its possible correction.

But this is a condition which no longer maintains. Modern light-sources, installed on illuminating engineering principles, can produce conditions equal to those of the best daylight illumination. Such conditions, however, cannot be obtained without a careful and systematic study of each particular problem. Improvements can frequently be suggested offhand by the illuminating engineer who has had experience in this particular line, but the last degrees of refinement necessary to reach the condition of daylight illumination requires more than a casual inspection and the installation of some particular type of light-source and accessory.

The human machine is subject to idiosyncracies which cannot be discovered and governed like the laws of mechanics, but which are quite as important in the final result. Thus, a mechanic may turn out more and better work on a machine of a certain make, which he believes to be superior, than he would on another machine exactly as good in every respect mechanically which he considered inferior. The mental attitude is a condition by no means to be neglected in determining the efficiency of workmen. This is particularly the case in matters of illumination. It is a common experience that a system of lighting which may be so enthusiastically received in one factory that the workmen are willing to pay for its up-keep themselves, rather than have it removed or changed, may be thrown out in another factory for the simple reason that the workmen will have none of it. In another case a workman will find that lighting best which he discovers that his "boss" prefers. The case is reported of a man who had to put on glasses when working under the mercury vapor lamp because his oculist had told him that the light was very hard on the eyes. On the other hand a number of cases are reported where workmen have found that they could dispose of their

glasses with perfect comfort to their eyes while working under this same light. In the long run, however, the best and largest output from a given set of operatives will be produced when the lighting conditions are those which are based upon proven scientific principles. Having determined what these principles are, it is usually a comparatively simple matter to remove prejudice and produce a favorable mental attitude toward them on the part of employees.

The lighting conditions as effecting output should be considered a special item in the cost system, and carefully analyzed and tested. There are almost no records of this kind in existence at the present time. It is no more a sufficient test of a system of lighting to put up one or two units and ask the opinion of the workman offhand than it would be to give him a new piece of machinery to which he is not accustomed, and immediately ask his opinion of it. In nine cases out of ten such opinion will be unfavorable. The proper method of procedure is to put up a sufficiently large installation to get an average on a considerable number of operatives, thereby eliminating the personal equation as far as possible by removing prejudice against the change, so that the mental attitude may at least be nothing more unfavorable than that of indifference; then to operate this installation for a sufficient period of time to get reliable figures as to the relation of output to labor. Figures so obtained would in many cases show astonishing results. To make the figures comparable, however, it would be necessary to either first keep a record of the same operatives working under present conditions; or, if there are opportunities, a section can be divided into equal parts, and the results compared under the different systems of illumination. There is absolutely no other way of settling the question as to the best methods of illumination for the different phases of industrial lighting. It is the industries themselves that will benefit by such investigations. They should, therefore, take the initiative, or at least give illuminating engineers every possible opporunity for carrying them out. Modern illumination, which enables industry to proceed uninterruptedly during the entire twenty-four hours of the day is one of the revolutionary advances in civilization, and is comparable to the invention of the steam engine and the dynamo electric generator.

Coming now to the general consideration of the methods of industrial lighting, we may at once divide them all into two classes: General illumination and special illumination.

In the former case a given amount of space is lighted irrespective of the position of machinery or benches, with the intention of furnishing sufficient general illumination to enable the necessary work to be done at any point in the room. In this plan an attempt is made to imitate daylight conditions.

In the latter case special illumination, generally from an individual light-source, is provided for the workman, the intention being to illuminate the particular field in which his work is performed. It is evident that there may be all degrees of combination of these two general plans, although many installations may be found in which either is carried out almost exclusively.

Neither illuminating engineers nor factory managers have yet reached a positive conclusion as to the relative merits of these two systems, and it will require more definite data of the kind already mentioned before such a conclusion can be reached. Where careful eye work must be done, as in the work of finer machine shops, textile industries, the manufacture of articles from leather and fabrics, special lighting probably is more used at the present time. In fact, until the modern light-sources became available special lighting was the only means giving any degree of satisfaction; but the powerful electric and gas lamps now obtainable make it possible to flood a room with light, so that it will even exceed the intensity of daylight, if desired. If effective illumination depended on nothing else than intensity on the working plane, or in the working field, the problem would be simple, but this is far from being the case. The eye is not a mere optical contrivance, but an exceedingly delicate phyiological organ, and the question of illumination involves its physiological action even more than its optical action.

Foolish Question, No. 999,999

One of the New York dailies has been giving a series of foolish questions and answers depicted by cartoons. The last of these bears the number 1,000,500, the list is far from being exhausted. At least one more can be furnished from the proceedings of the last meeting of the New York Section of the Illuminating Engineering Society, which was devoted to a discussion of the question, "What Is an Illuminating Engineer?" The discussion that took place was in itself well worth listening to. It brought out opinions on questions of philosophy, ethics, art, science and human nature which showed that the society has plenty of members who think deeply, and about many things besides polar curves and the price of gas. The value of a sermon is by no means to be judged by the wisdom of the text. A man possessed of ideas could preach quite as good a sermon from a text taken from Mother Goose's rhymes as from any other.

To set aside an entire session of a scientific society for the discussion of the question as to what its name means is certainly a strange commentary upon either the intelligence of the members or the phraseology of the name. That a society four years old should need to spend an evening trying to define itself is more in line with the plot of a Gilbert and Sullivan opera than the consideration of a scientific society.

As a matter of fact all this hullabaloo about "what is an illuminating engineer" is rank nonsense. A few minutes time spent in consulting any good dictionary will fully answer the question to any one who understands the English language. According to the Century Dictionary, an engineer is "a person skilled in the principles and practice of any department of engineering." Engineering is defined as "the art of constructing and using engines or machines." In this definition the word "engine" must, of course, be taken in its fundamental or broad sense, which is thus defined: "An instrumental agent, or agency, of any kind; anything used to effect a purpose; an instrumentality." Tracing the term back to its origin through these definitions, we find that an illuminating engineer is "a person skilled in the principles and art of constructing and using the instrumental agents concerned with illumination." If this definition seems long or involved, we may compare it with the definition of some of the other branches of engineering as given in the same dictionary; for instance, electrical engineering: "The science and art of utilizing electricity." Substituting the word "light" for "electricity," and we have an equally exact and brief definition of illuminating engineering.

The truth of the whole matter is that the question, "What is an illuminating engineer?" is not at all the one that has been in the minds of those whom it has most troubled. What they have evidently had in mind is, "*Who* is an illuminating engineer?" That is altogether a different matter, and a question impossible to answer. No amount of degrees from educational institutions, or memberships in scientific societies, can ever furnish exact data upon which to answer this question.

While no harm comes from within the

society by the constant repetition of this "foolish question," it certainly does not tend to enhance the opinion of the outsider as to the standing of illuminating engineering as a profession. What would be thought of the Architectural League, for instance, if it should get together to discuss the question, "What is an architect?" Or of the American Institute of Electrical Engineers spending an evening in defining the term "electrical engineer?"

It is true that the Illuminating Engineering Society and the profession are not yet as old as most other divisions of the great field of engineering, but it is at least old enough to have gotten past the kindergarten stage. The work that has been done, as evidenced by the Proceedings of the Society, bears as strong an impress of mature thought and study and familiarity with the scientific principles involved as does that of any other similar organization.

It is time that this talk about "infancy," "beginners" and "learning the rudiments" be given less prominence. Illuminating engineering as a science and profession to-day can stand squarely on its feet, and walk with a steady gait in its chosen direction. It no longer needs the nursing bottle nor the leading string. "When I was a child I thought as a child; but when I became a man I put away childish things." Is it not about time that we stopped thinking as a child, and began putting away our childish notions of illuminating engineering?

Engineering and Esthetics

The symposium of the New York Section of the Illuminating Engineering Society again brought out a question, which seems to have been as troublesome to the members as defining themselves—viz., as to whether or not an illuminating engineer must be an artist, or, more properly speaking, an artisan. It is on this point apparently that the illuminating engineer and architect have split. The statement was made by one member,—who spoke from experience,—that the man who entered an architect's office and announced himself as an illuminating engineer was forthwith given to understand that he was *persona non grata*. The admission was made by the same member that, in order to secure an audience, strategy was being resorted to by representing that an interview was desired on the *art* of illumination, and the coveted audience, once obtained, was devoted to impressing upon the architect the fact that there really was no such thing as illuminating engineering, but that what those misguided mortals calling themselves illuminating engineers should really seek is a "harmonious," esthetic effect. Having thrown this sop to Cerberus, the suppliant might then be received into the good graces of the architect. The speaker even went so far as to seriously propose that the society should change its name to accord with this strategy.

If this were a single instance it would hardly be worth consideration, but evidences of the same notions have been discovered in other quarters. We are not yet prepared to believe that the average architect is either so childish, or so possessed with the importance of his profession, that he needs to be cajoled into accepting service or ideas. The architect is, of necessity, a man who has to accept great responsibilities. He is not only responsible for the design of the building, including the opposite features of utility and art, but he is also the buffer between the client and an innumerable host of manufacturers and specialists, all ravenous for the slices and crumbs which he has to dispense. He is conservative, and justifiably so; experiments in building are hazardous. This condition can have no other effect than to create in the mind of the architect a somewhat dogged reliance upon his own personal judgment. It is therefore quite to be expected that, before he accepts the advice of an outsider on matters within his jurisdiction he is going to be quite sure that the person offering it is fitted by ability and experience to give advice that is reliable and valuable. The man who comes before him unknown and unheralded, with a proposition which virtually says, "I know more about this matter than you do, and you should therefore accept and pay for my advice," must expect to be asked for his credentials. When the illuminating engineer can present as undisputed credentials as the electrical engineer, or construction engineer, he will undoubtedly be

just as readily received. But apprenticeship with a commercial concern interested in the production of luminants or accessories will scarcely be a sufficient passport, especially if the illuminating engineer is still serving his apprenticeship.

Illuminating engineering as a profession will never become recognized by denying its own identity, nor by wheedling its logical clients; it will have to step boldly out into the open, and show by hard, practical facts that it has a right to exist along with the older professions.

Furthermore, engineering has no essential connection with esthetics in any form; the sooner the illuminating engineer gets this out of his head the better. So far as art has an application in building, it is entirely under the jurisdiction of the architect and the illuminating engineer has no more license to question or criticise it than has a nurse to criticise or dispute the physician's diagnosis of a case. The architect, having made clear what he wants to produce, may seek the engineer's advice as to the means of accomplishing that purpose most efficiently and economically. That is the extent of the engineer's prerogative. In his unofficial capacity, of course, an illuminating engineer is perfectly free to criticise anything and everything that he pleases, and to get as much attention to his criticisms as possible; but that is a wholly different matter from attempting to usurp the prerogatives of his clients.

If illuminating engineers will take heed of these two points; that from the very fact of their being engineers they have nothing to do with the esthetics of the subject of lighting, but that, as engineers, their work is essentially scientific and practical, they need to have no fears as to the reception which they will ultimately receive at the hands of all who have occasion to use their services, or of the position which their profession will take among the other branches of applied science.

The Standardization of Gas Mantles

The paper on "Practical Applications of Illuminating Engineering," presented at the recent meeting of the American Gas Institute by Mr. Norman Macbeth, the illuminating engineer of the Welsbach Company, again brings up forcibly the question of standard specifications for gas mantles. On this particular subject Mr. Macbeth says:

> A Standardizing Committee of this Association, acting with the manufacturers of gas lighting accessories, would seem to be a necessity. Mantles can then be required to meet specifications which have been determined by thorough tests to be satisfactory—standardized for size, color, cerium and thorium content, strength, weight and other points of importance. Mantles which show a depreciation of 10 per cent. in 1000 hours are certainly entitled to a different classification than that kind which will show a drop of 10 per cent. in 250 hours, and as much as 30 per cent., or in lower grades, 60 per cent. in 1000 hours.

The statements as to the variations in the quality of mantles will certainly be startling to the user, and probably also to a considerable number of illuminating engineers, and those concerned with the sale of gas. The condition is one which might be expected in a trade in which competition has been allowed to run on the question of price alone. Wherever such a condition exists it inevitably follows that the efforts which should be devoted to the improvement of quality as well as the reduction of manufacturing cost is devoted wholly to the latter, with the result that goods are produced whose inferiority is limited only by the carelessness of the buying public.

The conditions in the mantle industry are in striking contrast with those in the incandescent electric lamp industry. In the former case there is no standard and little general knowledge as to quality; result: a market flooded with goods that are expensive at any price. In the latter case the most rigid standardization and specifications exist; result: lamps that are practically uniform in quality, no matter of what make, and at a price that is neither burdensome to the user nor profitless to the manufacturer. An electric lamp that gave comparatively as poor results in use as a gas mantle whose efficiency runs off 60 per cent. in the course of its life could not be marketed at any price.

The subject is one which the institute may well take into serious consideration. Poor mantles are certainly a serious men-

ace to the progress of gas lighting and a gas company should no more countenance their use than would a central station the use of a worthless lamp. In either case the dissatisfaction on the part of the user is sure to work detriment to the producer of the luminant.

It is argued, even by some who should be in a position to speak from knowledge, that standardization of mantles is impracticable on account of the varying conditions in their manufacture. Those who are conversant with the extreme refinement of details in the process of making an incandescent electric lamp and the uniformity of results obtained will be inclined to look upon these excuses with a considerable degree of doubt. The specifications which Mr. Macbeth suggests are certainly capable of fulfillment to a very fair degree of accuracy, and there would seem to be no reason why they should not be put into practice.

There is no federal regulation at present requiring the chemical constitution and strength of a mantle to be stated upon the package, as in the case of prepared foods, and there is no prospect of any such law being enacted. The gas companies themselves, however, through their associations, have ample power to enforce whatever specifications they may agree upon. They are in continual personal touch with every user of gas, and their facilities for educating the public in this respect are such as to completely dominate the situation if they choose. Or, the mantle makers themselves might accomplish the purpose still more quickly by agreeing upon a system of specifications, as the electric lamp makers have. Whatever way it may be most effectively accomplished there is no doubt that the present practice of absolute irresponsibility on the part of the manufacturers as to the reliability of their product is prejudicial to the best interests of the gas industry and suitable means should be taken to remove the cause.

Ready-Made Illuminating Engineering

Who was it that prayed to be "saved from the hands of his friends?" Whoever he was, he would find some hearty sympathizers among illuminating engineers of the present day. The science has a number of professed friends who are so solicitous of its welfare that they are willing to take entire care of the offspring, acting as foster-mother, godfather and guardian—and doubtless also, at the proper season, as executor. Each of these friends ingenuously claims that its particular brand of food is all-sufficient for the subsistence and growth of the "young hopeful." Dropping the simile and speaking in plain language, there has been a decided tendency shown on the part of various commercial interests who are connected with the lighting field, and therefore properly concerned with illuminating engineering, to exploit the science for the purpose of promoting their own sales and to put forth the claim, at least by inference, that their particular line of goods covers the entire field of illumination. They then proceed to reduce the science to a set of simple rules and tables, so that illuminating engineering becomes merely a matter of finding a figure in a table, and perhaps making a simple arithmetical calculation.

To standardize practice in illuminating engineering as rapidly as sufficient and reliable data will permit is not only legitimate, but even a necessity, for the establishment of the science. The danger of the course pursued by the commercial illuminating engineers is twofold: first, it gives the unskilled an idea that by the use of a few figures and tables they can become illuminating engineers; and second, it gives to the skilled engineer in other branches of science and to the architect, the impression, which is unfortunately too widely spread at the present time, that the whole scheme of illuminating engineering is only a salesman's ruse.

A concern which has generally been considered foremost among commercial organizations making legitimate use of illuminating engineering has lapsed into this serious error, if the statements of its "house organ" can be taken as authority —and certainly if a "house organ" is anything it is an official expression of the principles and policy of the house which it represents. The following statement appears in a recent issue of the "house organ" referred to:

"There's not so much to this science of

illuminating engineering as some of the highbrows would have you believe. This science thing is all worked out in the design of the reflectors and globes. We put the science in our designs, and then we give you a few simple rules of how-to, and that's all there is to it 98 times in a hundred."

In other words, illuminating engineering is something to be put on like a garment, and "we have them ready-made to fit all sizes." While the design of a globe or reflector is an important question in illuminating engineering, it is a long way from comprehending the whole science, or anything approaching it. Of course such statements have no effect upon the skilled, independent illuminating engineer, but they are dangerously misleading to the layman and the other engineering professions.

However, we are inclined to the opinion that the statement quoted was merely a slip on the part of the publicity department—such slips have been known to occur before—rather than a serious pronunciamento from the engineering department. Nevertheless it does no good to the cause of illuminating engineering.

Illuminating Engineering as a College Course

We recently called attention to the rapidly increasing amount of attention being given to illuminating engineering subjects in the college, several of which are giving courses on the subject. We were hardly prepared, however, for the receipt of a letter having the following heading printed on the stationery:

DEPARTMENT OF
PHYSICS
AND ILLUMINATING ENGINEERING,
IOWA STATE COLLEGE,
AMES, IOWA.

This means the Iowa State College is the most thoroughly progressive technical school in this country, being the first to establish a department of illuminating engineering. A complete course will naturally follow this step, leading to the degree of illuminating engineer; so that there will be at least one institution turning out graduate illuminating engineers who are as much entitled to the degree and professional title as is the electrical, mechanical, mining or civil engineer.

The last bulletin published by the University of Minnesota has the following announcement among its various courses:

ILLUMINATING ENGINEERING,
Professor Shepardson.

Lectures and laboratory work. Investigation of performance of electric and gas lamps, reflectors and diffusers; luminous efficiency, distribution, color characteristics, physiological phenomena, methods of determining location, kind and quality of lights for obtaining desired illumination.

The desirability of having at least a preparatory course in illuminating engineering offered by colleges and technical schools is without question. It should be remarked, however, that a well defined branch of engineering may be developed and exist for a considerable length of time without this assistance or sanction of educational institutions. An example of this was referred to by Dr. A. H. Elliott in his discussion at the last meeting of the New York section of the Illuminating Engineering Society; it is only within the past year that an English college has established a regular course in gas engineering, it being the only institution in the world to recognize this branch of the science. And yet gas engineers and engineering have existed, not only as a distinct branch of science, but an important and well recognized one for nearly a hundred years. From present indications there seems no likelihood that illuminating engineering will need to wait a century for such recognition.

National Commercial Gas Association Exhibition

The coming exhibition of the National Commercial Gas Association, which will be held in Madison Square Garden, New York, from December 14 to 22, will be the most ambitious attempt ever made to show the public the various advantages and conveniences of illuminating gas. The opportunities which the subject offers for an interesting and instructive "show" are certainly large, and will, from all indications, be well utilized by those who have the work in hand.

Only one word need be said to the public, as well as those commercially interested: GO.

Notes and Comments

Illumination and Politics

CHEAPER RATES FOR ELECTRIC LIGHT MADE AN ISSUE IN THE MAYORALTY CAMPAIGN IN BUFFALO.

That Buffalo needs more and better public lighting has long been sufficiently evident to those who have had occasion to compare it with other cities. That it is rapidly awakening to the importance of the lighting question is being evidenced in many different directions. The latest of these is the public declaration of the Democratic candidate for Mayor, Mr. Louis B. Fuhrmann, who promises in case of his election to have the question of rates, etc., for electric light thoroughly investigated by the Public Service Commission.

Another of the evidences of interest is thus described in the *News:*

The display in William street last night suggests anew the value to Buffalo as a business investment of having its leading thoroughfares so well lighted as to make it a pleasure to visit them in the evening.

All the authorities agree that good lighting is the best aid that the police of any city can have in the work of keeping order and protecting business and property. Buffalo has advantages in this way of lighting that are not shared by any other city. Its electric lighting is furnished at less cost than is the case in any other large city in the United States. We should have not merely the side lights in the streets and avenues that radiate out from the central business section of the city, but we should have the great overhead lights which add so much to the appearance and the pleasure of walking in any street in that way.

Here's a "Dollar Idea"

THE CHARMS OF MUSIC ADDED TO THE GRACES OF ORATORY TO SECURE LIGHTING CONTRACT.

Many clever schemes have been proposed to aid the lighting company solicitor in the gentle art of persuasion, but none have disclosed so effective and novel a method as that recently brought to light by a lawsuit in Los Angeles. The details in this most interesting proceeding are thus described in the *Express:*

That music hath charms to soothe the savage breast has been exemplified, but to use the entrancing strains as a means of inducing residents to purchase illuminating gas, is a new wrinkle among solicitors that was made public for the first time before Justice of the Peace Ling yesterday.

To A. J. Bond, a solicitor for the gas company, is given credit for having won Mrs. Smith from a rival corporation.

"When he came with the burners he was accompanied by a Mr. Smith, who had a guitar. While Mr. Bond adjusted the burners Mr. Smith performed on the guitar. Judge, it was the most beautiful, heavenly music I ever heard, at times swelling into volume so that it was exhilarating, then again dropping into that seductive, sleeping melody that entranced me, and while I was sitting there drinking in every note and hanging expectantly on each as though it was to be the last, Mr. Bond placed that contract before me, and so fast was I held in the musical spell that I have but a most indistinct recollection of having signed it."

More Decorative Lighting for Rochester

ITS NEW RESERVOIR AND PARK TO BE BRILLIANTLY ILLUMINATED.

The well-deserved reputation of Rochester as being one of the best lighted of Eastern cities, as well as one of the earliest to take up better methods of public lighting, is being well maintained, as the following extract from the *Union-Advertiser* will show:

Lights are to be placed at intervals of 40 ft. around the entire reservoir on ornamental poles, set either inside the fence or outside the cement walk.

The reservoir grounds are being graded and shrubs and bulbs are being planted, so that by spring the park ought to present a handsome appearance. The many lights on the hill are expected to prove quite a prominent attraction at night, as they ought to be visible from any part of the city.

Demand for More Decorative Lighting Spreads in Minneapolis

SOUTH SIDE COMMERCIAL CLUB TAKES UP THE QUESTION.

The exceptionally fine installation of street lighting that was put up in Minneapolis about a year ago has been commented upon in these pages, as well as in the technical press generally. The first installation has been added to recently, and it is announced that by Thanksgiving there will be 250 of the ornamental standards in use in the city. Beside this, the Commercial Club of the South Side has

started the ball rolling, which assures an extension of the system to that side of the city in due time.

Incandescent Electric Lamps to Compete With Gas in Pittsburgh Street Lighting

RECENT ORDINANCES PROVIDES FOR BOTH KINDS.

Heretofore the use of incandescent electric lights in the sections lighted by incandescent mantles has not been contemplated. Yesterday when the ordinance authorizing a contract for incandescent mantle lighting, at a cost not to exceed $100,000 a year, came up in the Public Works Committee, W. G. Liggett offered an amendment inserting the words "and electric" after the words "incandescent mantle." It is asserted that the electric light companies can furnish light cheaper than the incandescent mantle companies can supply it. The amendment was approved and the ordinance in that shape was recommended favorably.—*Pittsburgh Gazette-Times.*

Better Lights for Less Money

THAT IS THE PROPOSITION OF THE LOCAL LIGHTING COMPANY TO THE CITY OF BRIDGEPORT, CONN.

The United Illuminating Company, of Bridgeport, wisely believes in discounting the future, thereby preventing the contingency of the future discounting their business. The magnitite lamp gives a far greater amount of light for a given amount of current than the present enclosed arc. It is only fair that both consumer and producer of electricity benefit from this improvement. To insure this, offers to replace the present arc lamp with a newer form, and at a reasonable reduction in cost to the city, is the equitable and sure way of forestalling public agitation which would lead to a general clamor for the installation of the improved lamps at the old rate, thereby securing the entire benefits of the improvement to the city. In this case the lighting company offers to enter into a new contract with the city, under which it will install magnetite lamps, giving much more light than the forms now in use, and at a lower cost to the city.

Public Opinion Differs as to Lighting Installation

CHICAGOANS NOT UNANIMOUS AS TO THE BEAUTY OF THEIR BOULEVARD LIGHTING.

Chicago has probably taken more trouble than any other city to secure designs for the lamp-posts of its new boulevard lighting, which should be absolutely above reproach as examples of art. Artists, sculptors, architects, art commissions and so on down the line have all taken a hand in the matter. That the results finally achieved do not meet with universal approval is only another evidence of the fact that art is mostly a matter of opinion and not of rule. The lamp standards of the last installation are of concrete. A leading architect describes them as beautiful and an ornament to the city, while some of the residents call the street "Tomb Stone Row." Some are elated over the brilliancy of the illumination, while others scornfully refer to it as "vulgar glare," and so on through the various extremes of criticism. In the end it is likely that every one will be glad of the better illumination, and would be very loath to see it replaced for the old time lighting.

Correspondence

Illumination Topics in Great Britain

By James A. Seager, Special Correspondent.

Undoubtedly the sensation of the past month has been the entry of the Welsbach Company into the arena of electric lighting competition. Not only has a severe shock been received by the average Briton, who has been accustomed to regard gas and electricity as inveterate enemies only to be equaled by the cat and dog, but one's breath has been somewhat taken away both by the sweeping declarations made on behalf of the Welsbach patents and also by the energetic measures which have been taken by the company to introduce their metal filament lamps. As regards the former point, the Welsbach Company claims that quite as much as Baron Welsbach was the discoverer of the scientific features underlying the construction of the incandescent gas mantles, it is this inventor who also possesses the pioneer patents regarding the metallic filaments now being made by that company. How this claim will be supported is only a matter which can be revealed by the stress of competition. It is a most involved subject, and one upon which such companies as the British Thomson Houston Company of Rugby, the General Electric Company of Witton, not to mention the host of other manufacturers of metallic filament lamps, will have something to say. As regards the methods adopted in order to get the lamp on the market, these may be divided as an offer to the public and an offer to the trade. The general public has been given an offer of free replacement of their carbon lamps by metal filament lamps of at least equal candle-power, a saving on the current consumption bill being taken by the Welsbach Company as their payment. It may be argued that this course may rather put the electricity supply companies' teeth on edge; while it also appears on first sight to trench upon the function of the local electrical contractor. The business management of the company will probably, however, be quite sufficient to cope satisfactorily with the problems raised in this way, and to protect the interests of all parties concerned. That the policy of the Welsbach Company is of a friendly disposition toward the general trade is shown by the fact that to the latter a policy of co-operation is offered. The company recognizes the difficulties and loss falling on the trade in the handling of the delicate filament lamps, and they guarantee safe delivery. Any claims arising out of this guarantee are dealt with promptly and every assistance appears to be given to agents (in which class is included any suitable electrician or dealer) for the mutual extension of business.

In the meantime other metallic filament lamp makers are by no means slothful in business, two of the lamps which are most up for attention at the present being the E. M. F. lamp and the Omega lamp. The former is made by E. M. F. Company, Ltd., of Cheapside, London, E. C., the particular point about the lamp being that special care is taken to secure an increase of toughness as compared with some of the other lamps at present on the market. On this account they are found to be capable of handling with much less risk of breaking, and can be sent by rail or post in cardboard boxes. They burn in any position on direct or alternating current, and have been designed to withstand the large fluctuations of voltage which occur on central station systems. The Omega lamp has already been

FIG. I.—POSTER USED IN ENGLAND FOR ADVERTISING OSRAM LAMPS.

on the market for some little time, and its popularity is increasing to such an extent that large new works have recently been erected by the Omega Lamp Company at Hammersmith, London. One of the guarantees given is that any lamp failing prematurely or blackening after short use will be replaced free of charge, and special attention is paid to the manufacture of a lamp suitable for street burning. These three examples give some idea as to the efforts which are now being made on the part of the metal filament lamp manufacturers in order to increase sales.

It may not be out of place in this connection to refer to a subject which, although hardly coming within the scope of scientific engineering, has certainly an important bearing on the commercial end of the business, is that of the methods adopted to advertise the lamps, and the indulgence of the readers of the *Illuminating Engineer* is claimed to two typical advertisements of metallic filament lamps which are now appearing in England. The first (Fig. 1) is that issued by the General Electric Company on behalf of the Osram lamp, and, apart from the fact that it is designed by Hassall, one of the most eminent of British poster artists, it may be pointed out that the appeal is made along the line of instruction, the cost per candle-power being made the dominant argument. This is a feature of most of the advertising appeals on behalf of illumination to the British public, and it shows that, although English people have contracted the "gas habit," the general standard of intelligence as regards illumination problems is sufficiently high to be appealed to.

The second advertisement, devoted to tantalum lamps, has its humorous aspect, and may here serve as an introduction to the fact that the growth of sale of the tantalum lamp in Great Britain has been so phenomenal that the Siemens Brothers' Dynamo Works, Ltd., who make this lamp, have been compelled to very largely increase the factory devoted to the production of the lamp at Dalston, in the northeast of London. This year Messrs. Siemens Brothers have put on the market a high voltage lamp for 200 to 250 volts circuit for single burning. These are made in sizes for 25 candle-power for direct current, and for 32 to 50 candle-power

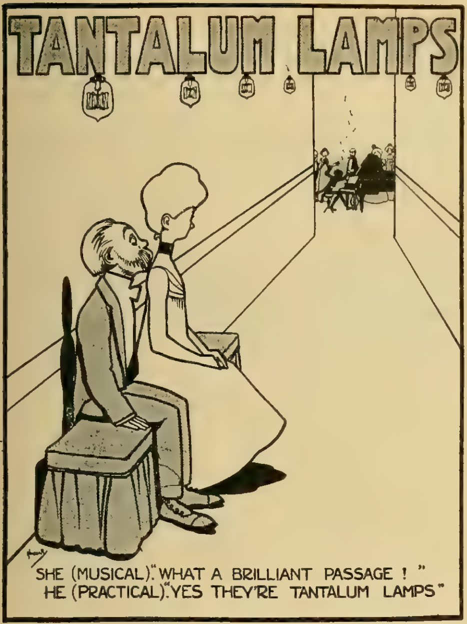


FIG. 2.—POSTER USED TO ADVERTISE TANTALUM LAMPS.

for either direct or alternating current. They have also put on the market a number of candle lamps for 24 to 40 volt circuits. These lamps are of an exceptionally neat design, and add considerably to any candelabra fitting on which they may be installed. They possess all the advantages claimed for the ordinary types of lamps, and are sold to the consumers at two shillings each. They have also placed on the market a number of tantalum battery lamps, the economy of this class of lamp accounting for the great demand which has been experienced in this direction.

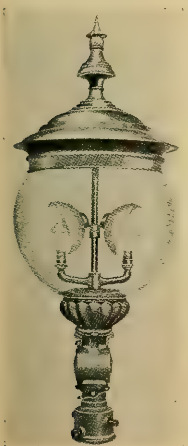


FIG. 3.

The advent of the metallic filament lamp has had a very stimulating effect upon the design of suitable street light fittings, as it has been recognized by British electrical engineers that by means of the metal filament lamp not only is arc lamp lighting obtaining a serious rival, but that there is great possibility of side street lighting becoming feasible. In a previous communication to the ILLUMINATING ENGINEER I made mention of Mr. Haydn Harrison's system of street lamp lighting, and further evidence of the importance of this subject is shown by the excellent series of new designs which the Reason Manufacturing Company, Ltd., of Brighton have put upon the market. It may be noted that one of the means by which this firm study the actual conditions of lighting is to send upon request an experienced engineer with a street photometer to any station in the United Kingdom if accurate measurements of candle-power are required. They are also prepared to carry out comparative tests and to ascertain the relative costs of the various systems of street lighting submitted to them. As a result they have developed some very interesting forms of lanterns, a few of which are shown herewith. Fig. 3 shows one of their most useful and consequently most popular types. The spherical globe is supported by a ring of rubber insertion and prevents dust or damp getting in; the central tube, passing right up to the top of the lantern, acts as a stud, upon which the finial is screwed, keeping the zinc canopy and globe in position. Silver glass reflectors are provided. Fig. 4 shows the type of double lamp bracket which the Reason company fit to tramway pole and arc lamp columns. The side lamps are made so that they can be readily adjusted to any angle with the line of the street. They are fitted with silvered glass reflectors by means of which the effective candle-power is increased to that shown by the figures on the illustration when using 16 candle-power lamps. Where Osram lamps are used the arms of the bracket are produced and bent over, so as to give a vertical position to the

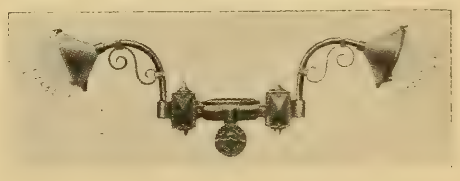


FIG. 4.—DOUBLE LAMP BRACKET.

FIG. 5.

metal filament. A rather interesting type of bracket is that known as the Swindon (Fig. 5), manufactured by the same company for a two or four-light fitting in which the necessity for a globe is entirely dispensed with. The reflector is a cone of enameled iron, which is practically indestructible, and will stand almost any amount of exposure, the lamp holders being so placed that it is impossible for rain to get at them and cause short circuits. The top hood and finial are of cast iron, and the whole fitting, which gives an exceptionally good lighting effect, is held together by a stout vertical piece of barrel.

While referring to the subject of incandescent lamps it is perhaps appropriate to refer to the unfortunate death of Mr. C. J. Robertson, the inventor of the Robertson lamp, who for so many years has been identified with the Robertson Electric Lamps, Ltd. Mr. Robertson, whose photograph is shown in Fig. 6, was associated with Mr. St. George Lane-Fox from 1879 to 1881, and, therefore, witnessed the inception of most of those processes upon which with important modifications the manufacture is still based. Later he was in control of the factories of two of the companies formed during the boom in English lamp manufacture, to make the Gatehouse lamp and the Bernstein lamp. When all the factories, except those working under the Edison patents, were closed Mr. Robertson removed to the continent and equipped and carried on a number of factories, becoming thoroughly versed in European and American practice. With the lapsing of the Edison patents, in 1893, the directors of the General Electric Company, Ltd., of Great Britain, found themselves in a position to make electric glow lamps, and Mr. Robertson found himself allied with a world-wide concern having plenty of capital, and Mr. Byng, the chairman of the General Electric Company, together with Mr. Robertson and the late Mr. J. Fraser, who afterward became the first chairman of Robertson Electric Lamps, Ltd., inaugurated this important concern, whose works at Brook Green, inaugurated in 1893, have since been extended four times to meet the enormous demands. Mr. Robertson's later history is identified with that of the firm which bears his name, and we cannot but regret the loss of a man who was so distiguished in the annals of British illuminating engineering.

FIG. 6.—MR. C. J. ROBERTSON.

CASHIER BOOKKEEPER CONTRACTS ADVERTISING

Commercial Engineering of Illumination

Specification Forms for Illuminating Engineering

The backwardness, amounting not infrequently to thinly veiled hostility to illuminating engineering, by fixture manufacturers has been frequently commented upon in these columns; also the fact that, while the older concerns were thus missing one of the greatest opportunities that has presented itself in any line of manufacture for a century, one of the newcomers in the field, by taking full advantage of the opportunity, was reaping a full return by way of commercial prosperity. Not only has this concern shown its appreciation of the scientific and technical sides of the problem of illumination, but has exhibited an unusual degree of originality and independence in the artistic design of its fixtures.

The majority of lighting installations are essentially utilitarian, the decorative treatment being merely incidental. Such installations manifestly afford opportunities for a considerable degree of standardization of practice. Furthermore there is generally a right and a wrong way, or at least a better or worse way, of putting up even the simplest lighting unit. Some of the worst effects in illumination are the results of the most evident carelessness or lack of consideration of very simple principles. To give plain directions and as much assistance as possible in installing a system of illumination, even if it consists of nothing more technical than putting up a set of lighting fixtures, is a decided step in advance of the methods that have generally prevailed in the fixture trade. While it is not put forward as comprehending the entire subject of illuminating engineering, the method exhibited in the forms shown is strictly in line with the principles and practice of the profession, and therefore worthy of consideration by both professional and layman.

The forms are neatly printed on paper of the legal size and bound with a document cover. Page 1 is as follows:

RECOMMENDATIONS FOR ILLUMINATION.

MADE BY THE ENGINEERING DEPARTMENT OF THE ——— COMPANY.

For *John Doe Company,* 155 *Main street, Columbus, Ga.*
Date *September* 15, 1909,
Number *A*-499.

This recommendation made by the Engineering Department of the ——— Company contains the following information:

Number of outlets and location of outlets.

Number and size of lamps for each outlet.

Number and style of reflector for each lamp.

Dimensions of fixture recommended for each outlet.

Spacing of outlets shown on blue prints.

Summary showing total number of each kind fixture, reflector and lamp.

This recommendation is based on *Letter and Pencil sketch.*

Furnished by *Criterion Electric Construction Company, Columbus, Ga.*

Made by *Same.*

Outlet No. 25 *in space* 3 *is located over stairway landing.*

No recommendation made for second floor. Not desired.

Brackets at outlets 23 *and* 24 *located* 7 *feet from floor on either side of mirror in space* 3.

Raise of floor in space 3 *one foot higher than in space* 2 *requires close ceiling type Tungstoliers.*

Total connected load all lamps burning 3.4 *K.W.*

Average intensity of illumination in main store room 5 *foot candles.*

Page 2 is a ruled form, of which the following is a sample:

EQUIPMENT

FLOOR									BLUE PRINT SHEET NUMBER					
Number of Space	Name of Space	Number of Outlets	Number of Tungstoliers	Tungstolier Number	Number of Lights each	Length	Spread		Type of Reflector	Finish of Reflector	Type of Holder	Size Lamp (watts)	Clear or Bowl Frosted	Spacing or Remarks

Pages 3 and 4 are data sheets as follows:

INSTALLATION DATA.

The effectiveness of a Plan of Illumination may be easily ruined if the various lighting units (by lighting unit is meant the light source. A fixture with lamps and reflectors is considered a unit) are not placed in the proper position to give the illumination planned.

If a certain combination of lamps and reflectors (lighting units) will illuminate a certain space when hung at a given height (H in table below) the distance between the lighting units (S in table below) is definite and should not be varied.

The distance between the lighting units (spacing) is denoted by S in the illustration and in the table.

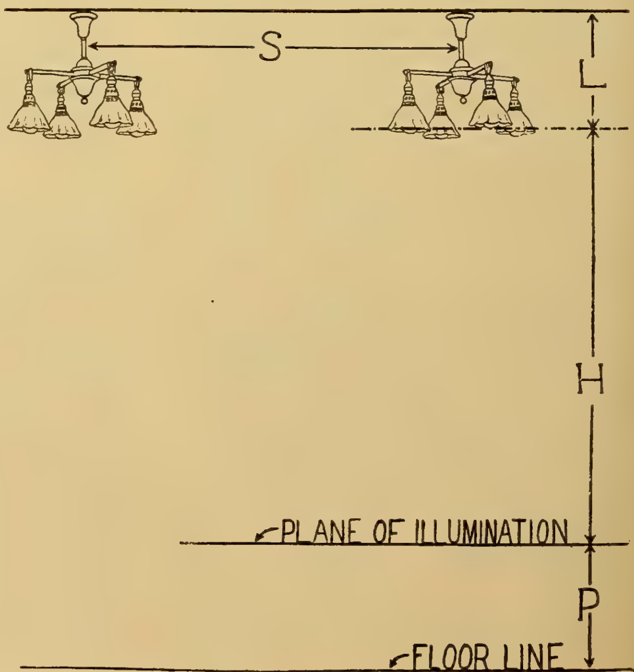
The length of the unit is denoted by L.

The height above the plane of illumination is denoted by H.

The height from the floor to the bottom of the lamps and reflectors is obtained by adding H and P.

The height of the plane of illumination is denoted by P, which is the average height of the top of tables, desks and counters.

FLOOR	SPACE	S	L	H	P



Pages 5, 6 and 7 contain illustrations of the several types of fixtures offered.

The purpose of these forms is primarily to assist central stations and fixture

dealers in handling illuminating problems. As compared with the old practice of sending a salesman around, who took a look over the premises, and made a mental picture of the conditions, from which directions as to what and how many lamps to hang up were made by inspiration and rule of thumb, the methods here outlined show a very distinct improvement in both theory and practice.

ENGINEERING DEPARTMENT

PLAN OF ILLUMINATION

No. A-499
For JOHN DOE CO

City COLUMBUS
Street 155 MAIN
State GA
1 Sheets in all
Sheet Number 1
For MAIN FLOOR
Business CLOTHING
Color of Ceiling WHITE
Color of Walls BLUE TINT
Scale 1/8 inches = 1 ft. 0 in.
Ceiling Height 15 Feet

EQUIPMENT

Space 1 — 1 To 12
Tungstolier 2511 Lights 1
Length 20 in. Spread 6 in
Reflector F-5 Lamp 40 Watt

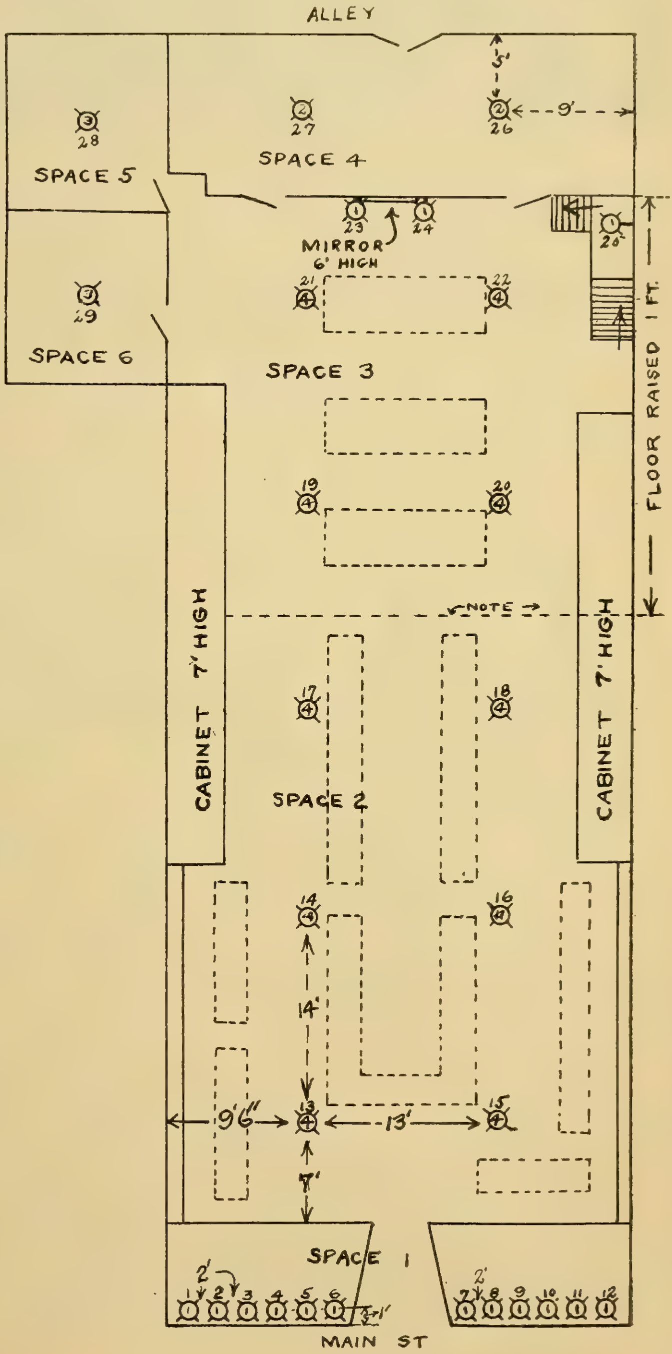
Space 2 — 13 To 18
Tungstolier 2514 Lights 4
Length 25 in. Spread 20 in
Reflector I-7 Lamp 60 Watt

Space 3 — 19 To 22
Tungstolier 2504 Lights 4
Length 15 in. Spread 20 in
Reflector I-7 Lamp 60 Watt

Space 3 — 23 To 25
Tungstolier 2711 Lights 1
Length WALL BKT in. Spread in
Reflector E-5 Lamp 40 Watt

Space 4 — 26-27
Tungstolier 2012 Lights 2
Length 25 in. Spread 15 in
Reflector E-5 Lamp 40 Watt

Space 5-6 — 28-29
Tungstolier 2013 Lights 3
Length 25 in. Spread 15 in
Reflector E-5 Lamp 40 Watt



Specification Forms for Lighting Installations.

The fixture trade has been very slow to take the advent of illuminating engineering seriously, to their own detriment rather than to that of the profession. There have, however, been some notable exceptions to the rule, and, generally speaking, the fixture manufacturers are awakening to the fact that it is not inimical to their interests, but, on the contrary, a very powerful influence for better trade conditions. Among the companies who were the earliest to recognize the science and to make it a basis of operation is the Tungstolier Company, of Cleveland, Ohio. This company has recently issued a set of standard specifications and data sheets which aim to assist electrical contractors and fixture dealers in the everyday problems of commercial lighting. While such problems do not, by their very nature, involve the most intricate problems in illuminating engineering, they nevertheless should be considered from the engineering standpoint. Simple problems require simple answers; but simple mistakes, especially in lighting, may lead to very serious results. It is the results of such simple mistakes that have led to the innumerable poor installations that are now to be found.

The specification forms referred to will be of very material assistance in preventing loose practice, and in substituting more systematic and scientific methods. This course on the part of the Tungstolier Company represents a distinct advance in the general selling methods of the fixture trade, and therefore deserves the commendation of the illuminating engineering profession.

Standard Symbols for Wiring Plans.

If the National Electrical Contractors' Association had accomplished nothing else than the preparation of a complete system of symbols to be used in electrical wiring specifications, and secured their official adoption by the authorities most interested, it would have entirely justified its existence. Like all other standardizations these symbols are highly conducive to accuracy, uniformity and economy in the work of specifying and executing electrical wiring contracts, and should, therefore, be put into use as rapidly as possible.

As illuminating engineers deal more frequently with electricity than any other luminant, it becomes a matter of importance for them to be familiar with all the practices of electrical wiring. Hence the value of these symbols to the profession. For the convenience of our readers we again insert the list of symbols, with their explanations, and strongly urge their use wherever there may be opportunity. Their official adoption by the Illuminating Engineering Society will undoubtedly be authorized as soon as the matter can go through the proper committees, who now have it under advisement.

If the Contractors' Association has not already done so, it would be well for them to see that the linotype and monotype manufacturers prepare matrices for these symbols, so that they can readily be used by the technical journals and by printers.

Now that the symbols are available for electric wiring, it would also be well for the American Gas Institute to take up the matter either of adapting these symbols to gas fitting or devising a similar system.

STANDARD SYMBOLS FOR WIRING PLANS

AS ADOPTED AND RECOMMENDED BY

THE NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION OF THE UNITED STATES and THE AMERICAN INSTITUTE OF ARCHITECTS.

Copies may be had on application to the Sec'y of The Nat. Elec. Cont. Associ'n. Utica, N. Y., and the Sec'y of The American Instit. of Architects, Washington, D. C.

Ceiling Outlet; Electric only. Numeral in center indicates number of Standard 16 C. P. Incandescent Lamps.

Ceiling Outlet; Combination. $\frac{4}{2}$ indicates 4-16 C. P. Standard Incandescent Lamps and 2 Gas Burners. If gas only

Bracket Outlet; Electric only. Numeral in center indicates number of Standard 16 C. P. Incandescent Lamps.

Bracket Outlet; Combination. $\frac{4}{2}$ indicates 4-16 C. P. Standard Incandescent Lamps and 2 Gas Burners. If gas only

Wall or Baseboard Receptacle Outlet. Numeral in center indicates number of Standard 16 C. P. Incandescent Lamps.

Floor Outlet. Numeral in center indicates number of Standard 16 C. P. Incandescent Lamps.

Outlet for Outdoor Standard or Pedestal; Electric only. Numeral indicates number of Stand. 16 C. P. Lamps.

Outlet for Outdoor Standard or Pedestal; Combination. $\frac{6}{6}$ indicates 6-16 C. P. Stand. Incan. Lamps; 6 Gas Burners.

Drop Cord Outlet.

One Light Outlet, for Lamp Receptacle.

Arc Lamp Outlet.

Special Outlet, for Lighting, Heating and Power Current, as described in Specifications.

Ceiling Fan Outlet.

S^1 S. P. Switch Outlet.

S^2 D. P. Switch Outlet.

S^3 3-Way Switch Outlet.

S^4 4-Way Switch Outlet.

S^D Automatic Door Switch Outlet.

S^E Electrolier Switch Outlet.

Show as many Symbols as there are Switches. Or in case of a very large group of Switches, indicate number of Switches by a Roman numeral, thus: S^1 XII, meaning 12 Single Pole Switches.

Describe Type of Switch in Specifications, that is, Flush or Surface, Push Button or Snap.

Meter Outlet.

Distribution Panel.

Junction or Pull Box.

Motor Outlet; Numeral in center indicates Horse Power.

Motor Control Outlet.

Transformer.

Main or Feeder run concealed under Floor.

Main or Feeder run concealed under Floor above.

Main or Feeder run exposed.

Branch Circuit run concealed under Floor.

Branch Circuit run concealed under Floor above.

Branch Circuit run exposed.

Pole Line.

Riser.

Telephone Outlet; Private Service.

Telephone Outlet; Public Service.

Bell Outlet.

Buzzer Outlet.

Push Button Outlet; Numeral indicates number of Pushes.

Annunciator; Numeral indicates number of Points.

Speaking Tube.

Watchman Clock Outlet.

Watchman Station Outlet.

Master Time Clock Outlet.

Secondary Time Clock Outlet.

Door Opener.

Special Outlet; for Signal Systems, as described in Specifications.

Battery Outlet.

Circuit for Clock, Telephone, Bell or other Service, run under Floor, concealed.
Kind of Service wanted ascertained by Symbol to which line connects.

Circuit for Clock, Telephone, Bell or other Service, run under Floor above, concealed
Kind of Service wanted ascertained by Symbol to which line connects.

SUGGESTIONS IN CONNECTION WITH STANDARD SYMBOLS FOR WIRING PLANS

It is important that ample space be allowed for the installation of mains, feeders, branches and distribution panels.

It is desirable that a key to the symbols used accompany all plans.

If mains, feeders, branches and distribution panels are shown on the plans, it is desirable that they be designated by letters or numbers.

Heights of Centre of Wall Outlets (unless otherwise specified)

Living Rooms	5′ 6″
Chambers	5′ 0″
Offices	6′ 0″
Corridors	6′ 3″

Height of Switches (unless otherwise specified) 4′ 0″

NOTE—If other than Standard 16 C. P. Incandescent lamps are desired, Specifications should describe capacity of Lamp to be used.

Proceedings of Technical Societies

PROCEEDINGS DISCUSSION

PRACTICAL APPLICATIONS OF ILLUMINATING ENGINEERING, by Norman Macbeth; presented at the Fourth Annual Meeting of the American Gas Institute, Detroit.

This is probably the most valuable single paper on the application of illuminating engineering to gas that has yet appeared. It gives the results of investigations that have been in course of execution for a year past, as well as facts obtained by the writer's large and practical experience with the subject. His reference to the matter of standardization of mantles is referred to in the Editorial Department.

The introductory paragraphs are particularly worth heeding:

In one of the recent numbers of the technical press, the statement is made "that electricity had gotten such a good start and prospered until to-day it is nip and tuck for business between gas and electricity. . . . The lighting and small power business is going the electric way in bounds and that gas for lighting will be discredited everywhere unless something is done to give the people something better for a less price."

Looking at the above statement broadly, we are forced to admit that it is true. From a somewhat inside knowledge of the situation, however, the writer is of the opinion that while undoubtedly the average gas man has not made the most of his opportunities, nor taken advantage of all the openings afforded him, he is not lazy, but badly handicapped for necessary information which would have a direct bearing on his sales.

The situation is largely one of salesmanship. Salesmanship alone, however, would not go very far unless backed with appliances and service, which are all that they should be, or at least as represented. Thorough maintenance is necessary, attractive and artistic glassware and fixtures desirable, and a proper treatment of the installation, from the standpoint of effective illumination, absolutely essential.

Regarding the "something better for a less price" statement, the writer is of the opinion that the "something better" is of vastly more importance than the lesser price. The best, however, is in the end always the least expensive. "Satisfactory service" carries and commands a high capitalization. Top notch maintenance at a dollar is more acceptable to the consumer than poor, indifferent service at a quarter of that cost. A good lamp or mantle is better than a poor one, and is always worth the additional cost. Cheap, unsatisfactory mantles and equipment have done their full share to depreciate gas illumination. To the consumer and to many gas men, mantles and lamps differ only in price.

The variation in efficiency for different burners under different pressures is discussed, and results of tests shown. After giving plain definitions of the three units of measurement used in illuminating engineering, the writer then gives the following as the necessary intensities of illumination for different classes of installations:

Class of service.	Illumination in foot-candles.
1. Storerooms, warehouses, etc..	.5 to 1.5
2. Residence and reading rooms.	1 to 3
3. General stores	1 to 3
4. Dry goods stores	4 to 7
5. Clothing stores	4 to 7
6. Detail work tables	5 to 15
7. Show windows	10 to 50

Following this is a table giving the lumens per cubic foot of gas per hour for different standard modern gas lamps under different conditions of illumination. This table is of similar character to the one published by Cravath & Lansingh for electric units, and is the first reliable tabulation of data on the subject that has appeared:

Lighting Unit.	Nominal consumption of unit cu. ft.	Factors. Lumens per cu. ft. of gas per hr. Light ceiling — With light walls	With dark walls
Reflex lamps with frosted tip cylinders, Welsbach-holophane or light (imported) opal concentrating reflectors	3 1-3	125	114
Reflex lamps with frosted tip cylinders, Welsbach-holophane or light (imported) opal distributing reflectors	3 1-3	110	100
Reflex lamps with frosted tip cylinders, French roughed ball globe	3 1-3	95	70
Reflex cluster lamp, 4-mantle, with alabaster globe	13	85	64
Inverted 5-mantle arc with alabaster globe	16.6	87	65
Upright 4-mantle arc with opal reflector and alabaster globe	20	75	55
Upright 4-mantle arc with alabaster globe only	20	66	48

The following spacing rules should be of great practical value:

In large rooms, reflex lamps with reflectors on single or multiple fixtures should be suspended 7 to 17 ft. above the plane or approximately 9 to 18 ft. above the floor, with the distances between outlets not exceeding 1 2-3 times the height of the lamps (to mantle centers) *above the plane*. With roughed balls the distance should not exceed twice the height. In rooms with low ceilings, single lamp units may be required with proportionate distances apart, as given above.

Inverted cluster and inverted arc lamps should be suspended not lower than 7 ft. above the plane, and with the distances between outlets not exceeding two times the height *above the plane*.

Distribution curves for the standard types of upright and inverted burners are also additional matter of importance.

Show window lighting is carefully treated, the distribution curves of reflectors best adapted to this purpose when used with inverted burners being given.

It is seldom that a paper containing such an amount of condensed practical matter is presented. It amounts almost to a small textbook on the subject, and should be in the hands of every employee of a gas company who in any way deals with the problem of illumination.

The Titanium Arc, by William S. Weedon; presented at the sixteenth general meeting of the American Electro-Chemical Society, New York.

The paper is a comprehensive review of the work thus far accomplished in developing this form of arc. The titanium carbide arc described gives a very decided horizontal distribution curve. The efficiency in mean spherical candle-power is .51 watt and .37 watt per mean hemispherical candle-power, which is somewhat less than the reported efficiency of the so-called regenerative flaming arc lamp.

Illuminating Engineering Society

The October meetings of the Sections were devoted to a discussion of the Convention papers.

The November meeting of the New York Section was devoted to a discussion of the question, "What Is an Illuminating Engineer?" and of the proposed "division of membership" by the creation of a class of members to be known as "Fellows." At the close of the meeting a motion was carried expressing the sense of the Section as against the proposed plan.

At the November meeting of the Philadelphia Section, Mr. V. R. Lansingh gave an address on the "Principles of Shades and Reflectors."

The Chicago and Boston sections discussed Convention papers.

American Items

NEW BOOKS.

Radiation, Light and Illumination, by Charles Proteus Steinmetz, A.M., Ph.D. Compiled and edited by Joseph Le Roy Hayden. 288 pp. Cloth. $3.00 net. McGraw-Hill Book Co., New York.

The book is a compilation from the course of lectures given by the author to the senior students in electrical engineering at Union University, Schenectady, N. Y. While it was neither the intention of the author nor editor to provide a textbook on illuminating engineering, there is not a subject treated that is not of interest to the illuminating engineer. Higher mathematics are used in dealing with the subject of light flux and distribution, but the explanatory matter is sufficient to enable the main points to be grasped by those who are unfamiliar with the mathematical demonstrations. While it is not the purpose of such a book to present strictly new matter, it is up to date in all the matters treated.

Dr. Steinmetz has a rare talent in classifying scientific facts, and in explaining them in a clear and accurate manner. Whatever other books the illuminating engineer or the student of the subject possesses, or contemplates possessing, this work of Dr. Steinmetz should unquestionably be included.

The Tungsten Lamp, by Frederick T. Benson; (*Merchants' Record and Show Window,* November).

The second of a series of articles on the subject of store and window lighting. Principally devoted to a description of the lighting of a large Chicago store by means of tungsten lamps.

The Operation of Enclosed Arc Lamps, by R. H. Fenkhausen (*Power and the Engineer,* Nov. 16).

The article is fully illustrated with diagrams of the different types of enclosed arc lamps and treats of their construction, method of operation, how to care for them and the troubles to be expected. A clearly written article for the layman and stationary engineer.

High Voltage Tungsten System in Residential Lighting, by Frederick Wells Pierce (*Electrical Age,* October).

There is evidently a clerical error in the title, since the article discusses the effect of the high efficiency lamp in residential lighting from the central station viewpoint, and puts forth facts and arguments to sustain the proposition that the low-voltage tungsten lamp offers the only solution of the problem.

Comparison of Tungsten and Gasoline Lighting (*Selling Electricity,* October).

The comparison is made by considering the illumination of a large room, ordinary finish and height, equipped with bowl frosted tungsten units, with bowl reflectors, and gasoline lamps with chimney and mantle only, burning 2.2 gallons of gasoline per mantle per 100 hours. According to the conclusions reached the tungsten lamp illumination is 14 per cent.

cheaper. A careful scrutiny of the figures, however, shows that this result is arrived at by the old trick of measuring only "useful illumination," and presumably on some plane near the floor, and by using an efficient reflector with the tungsten lamp and no reflector at all with the gasoline lamp. All the arguments against the use of gasoline are then presented. It would seem hardly worth while for the electric interests to juggle figures in order to make the tungsten lamp appear more efficient than the gasoline lamp. The cases in which gasoline lighting and electric lighting come into competition are so rare that the game is hardly worth the candle. In making comparisons of efficiencies of light units either their total flux without any accessories, or their flux when equipped with accessories, giving practically the same distribution, should be used—which has not been done in this case. It is rather the principle of the thing than the importance of this particular comparison that is important.

On the Electrical Character of the Source of Light Radiation, by T. B. Irving (*Physical Review*, September).

The report of a research by the author on the electrical and spectroscopic characters of the divided Bunsen flame, both in its simple state and when colored by the metals or salts.

A Study of the Reflecting Power of Metals as Dependent on the Refractive Index of the Surrounding Medium, by L. R. Ingersoll and R. T. Birge (*Physical Review*, October).

The purpose of the paper, as stated by the authors, is an experimental study of the reflecting power of metals in media (*i. e.*, liquids) of various optical intensities.

Tungsten Lighting and Its Effect Upon Building Costs (*Record and Guide*, Oct. 23).

An interview with Mr. P. R. Moses, consulting electrical engineer, as an example of the economies effected in isolated plants by the use of tungsten lamps, Mr. Moses cites the case where the estimated cost of the plant for carbon filament lamps was $36,000, but by the use of tungsten lamps the cost was reduced to $24,000.

Illumination and Imagination (*Optical Journal*, November).

A psychological discussion of the relation of visual perception to mental conception.

Light Studies (leading article in the new department of "Lighting—Gas and Electric," *Engineering Review*, October).

The phenomena of refraction is described.

Population, Consumers and Lamps, by Alton D. Adams (*Electrical World*, Nov. 4).

A calculation of statistics on the subject. From these statistics the writer draws the following conclusion:

> Towns show the greatest percentage of electric light consumers and the greatest number of connected lamps in relation to population, and where there are numerous manufacturing plants of moderate size a town may also lead in the average number of lamps per consumer.

Street Lighting Abroad, by H. Thurston Owens (*Electrical Review and Western Electrician*, Nov. 13).

The article shows the most modern installations of street lighting in a number of the principal European cities.

The Progress of Illuminating Engineering (editorial; *Engineering Record*, Oct. 30).

The gist of the argument may be found in the following:

> But how about the results? Has the effort at improvement of the methods of artificial illumination actually met with the success that was to be hoped for at the start? Does it represent a real engineering development? At the present time a sufficient amount of practical work has been accomplished to make one very well justified in answering both of these questions in the affirmative.

Portola Illumination (*Journal of Electricity, Power and Gas*, Oct. 30).

A short description with illustrations of the special illumination for the Portola Celebration, San Francisco, Cal.

Foreign Items

COMPILED BY J. S. DOW.

ILLUMINATION.

STANDARDIZATION, by H. Adams (presidential address before the Association of Engineers in Charge, London).

The author includes in the address some remarks on standards of light and makes special reference to the Helium tube standard on which experiments have been made by Mr. P. G. Nutting at the Bureau of Standards.

EDITORIAL: PROGRESS IN LIGHTING (*Electrician,* Oct. 15).

LIGHT IN CUSTOM AND SUPERSTITION, by Dr. M. Gaster (*Illum. Eng.,* Lond., October).

The author shows how religious ideas and superstition are frequently intermingled and traces the growth of religious ceremonies demanding the use of fire and light.

PRIVATE LIGHTING OF STREETS IN AMERICA, by G. Marston (*Elec. Times,* Oct. 7).

Gives some instances of private cooperation to improve street lighting in the United States, and shows how illumination can be used to foster business, especially in connection with the shops that line the streets.

THE LIGHTING OF THE HOUSES OF PARLIAMENT (*Illum. Eng.,* Lond., October).

The author recalls some particulars regarding the old methods of lighting employed in the Houses of Parliament in London and the Palace of Westminster. He shows how the introduction of new illuminants was viewed with concern; so much so that on one occasion when gas lighting was first suggested Dr. D. B. Reid, who put forward the proposition, was met with the reply, "Do what you will for the acoustics and ventilation, but take it as a fixed and settled point that wax candles remain!"

LONDON'S ELECTRIC LIGHT STANDARDS (*Elec. Industries,* Sept. 1).

Some remarks upon the views recently expressed in *The Builder* on the subject of the design of electric light standards in London (see previous review).

THE LOCAL GOVERNMENT BOARD AND THE LIGHTING OF FINCHLEY (*G. W.,* Oct. 16).

Several papers, both gas and electric, in Great Britain comment upon the action of the local government board in seeking to enforce its views on street lighting on local bodies. It is felt in some quarters that such action is only justified when backed by powerful expert, impartial advice and support, such as is not adequately provided at present.

ARTIFICIAL LIGHT (*Irish Builder and Engineer*).

PHOTOMETRY.

THE PHOTOMETRY OF DIFFERENTLY COLORED LIGHTS, by Morris Airey (*Electrician,* Aug. 30).

Correspondence dealing with the point raised in the article by Wild (see previous review, September). Wild found that when comparing tungsten and carbon filament electric lamps different results were obtained, according as "equality of brightness" or "flicker" instruments were used. The present writer seeks to explain this physiologically by reference to the theory of the rods and cones.

NEUERE FORTSCHRITTE AUF DEM GEBIETE DER SELENPHOTOMETRIE, by E. E. Presser (*Schweiz. E. T. Z.,* Aug. 28).

A continuation of the serial article on the use of selenium in photometry. The author takes the standpoint that at present this substance can only be effectively utilized on an indirect basis, *i. e., comparatively,* and he describes several arrangements for making use of the substance in this way.

THE SIMPLE EXPLANATION OF CALCULATION OF PHOTOMETRIC QUANTITIES, ETC., by Dr. L. Bloch (*Illum. Eng.,* Lond., October).

In the present installment of this arti-

cle the author describes a number of approximate methods and formulæ for the calculation of mean spherical and mean hemispherical candle-power from the polar curve of light distribution of an illuminant.

MODERN PHOTOMETRY, by Professor H. Strache (*Illum. Eng.*, Lond., October).

ILLUMINATION: ITS DISTRIBUTION AND MEASUREMENT, by A. P. Trotter (Continued; *Illum. Eng.*, Lond., October, 1909).

The author takes up the subject of illumination-photometry. He makes some general remarks on the qualities which instruments of this kind possess and refers to several early types developed by himself and Sir William Preece.

BEITRAG ZUR PHOTOMETRIERUNG LINEARER LICHTQUELLEN, by E. W. Weinbeer (*Z. f. B.*, Oct. 10).

ELECTRIC LIGHTING.

REMARQUE SUR UNE LOI EMPIRIQUE DE CONSOMMATION DES LAMPES À INCANDESCENCE À FILAMENT METALLIQUE, by H. Chretien (*Rev. Electrique*, Oct. 15).

MODERN INCANDESCENT ELECTRIC LAMPS, by A. C. Jolley (*Electrician*, Aug. 13, 20).

Two articles of a scientific nature dealing with the radiation phenomena underlying the behavior of tungsten and metallic filament lamps. That by Jolley is much the longer of the two. The author estimates the temperature of incandescence of various filaments. Chretien merely states the law connecting luminous intensity and temperature, suggesting that the light emitted is proportional to the twelfth power of the temperature of incandescence.

VIE UTILE DES LAMPES À FILAMENT METALLIQUE, by Henry (*L'Electricien*, Oct. 2).

DOMESTIC ELECTRIFICATION (*Electrical Times*, Oct. 14; Special Number).

TWELVE MONTHS' PROGRESS IN THE USE OF METALLIC FILAMENT LAMPS FOR STREET LIGHTING (*Electrician*, Oct. 15).

THE DOWNWARD TENDENCY IN CANDLE-POWER OF METALLIC FILAMENT LAMPS (*Electrical Times*, Oct. 7).

FORTSCHRITTE AUF DEM GEVIETE DER ELEKTROTECHNIK; (1) BOGENLAMPEN, (2) GLÜHLAMPEN (*Elektrot. u. Masch*, Oct. 3, Oct. 10).

A serviceable summary of recent patent literature relating to improvements in details of arc lamps and glow lamps.

THE WELSBACH OFFER (*Electricity*, Oct. 1; *J. G. L.*, Sept. 28; *Elec. Times*, Sept. 30; *Elec. Industries*, Sept. 29).

Discusses the recent decision of the Welsbach company in Great Britain to supply electric glow lamps as well as incandescent mantles.

BESCHLAGFREIE FLAMMENBOGENLAMPEN (*E. T. Z.*, Sept. 23).

NEUE FLAMMENBOGEN-ARMATUREN, (*Z. f. B.*, Oct. 10).

Refers to a new form of "deposit-free" flame arc lamp globe brought out in Germany.

THE JANDUS REGENERATIVE ARC (*Elec. Times*, Sept. 30).

A NEW ELECTRIC SIGN (*Elec. Times*, Oct. 7).

EINE NEUE LEUCHTREKLAME (*Oesterr.-Ungar. Installateur*, Aug. 14).

These two articles describe recent developments in electric signs. That referred to in the *Electrical Times* is a multi-colored type provided with switching devices. The method described in the *Oesterr.-Ungar. Installateur* is at once simple and ingenious. A plate of opal glass is covered with some adhesive, sticky black material and illuminated from behind. An operator behind the screen scrapes any writing he chooses on this surface with a pointed stick. The writing, where the ink has been rubbed off, appears brightly illuminated, and has the appearance of a motto written in fire on a dark background by an invisible hand. Subse-

quently a new coating ink can be applied and a new motto written out.

GAS, OIL, ACETYLENE LIGHTING, ETC.

Der Kunstseide Glühkorper, by Dr. C. R. Böhm (*J. f. G.*, Sept. 25).

An article devoted to the technicalities of incandescent mantle manufacture, special attention being given to the artificial silk variety.

Pressgasbeleuchtung, by R. Bremer (continued; *Z. f. B.*, Sept. 30).

What Quality of Gas Is Called For? by H. Bunte (*J. G. L.*, Sept. 30; translation).

Editorials: The Best Gas, The "Metropolitan" No. 2 Burner (*J. G. L.*, Oct. 12).

The above two articles discuss the old question, Which is the best quality of gas for illuminating purposes with incandescent mantles? In this connection reference is also made to the suggestion to attain uniformity in testing gas in Great Britain by the general adoption of the No. 2 Metropolitan Burner. Besides a much needed simplification, this would have the effect of favoring the varieties of gas best adapted for incandescent uses.

Editorials: Incandescent Burners and Electric Lamps (*G. W.*, Oct. 2).

The Flashpoint and Other Qualities of Petroleum for Illuminating Purposes, by C. Charitschkoff (*Illum. Eng.*, Lond., October).

The author suggests that the restrictions as to flashpoint of petroleum so generally enforced are not of much use in determining its value as an illuminant. Indeed, he thinks that a better variety of oil for such purposes could often be secured by allowing a higher flashpoint than is usually regarded as legal.

Acetylene Lamps and Generators, by J. H. Ross (*Acetylene*, October).

Automatic Air Regulation in Inverted Burners (*G. W.*, Oct. 2).

The Development of Inverted Incandescent Gas Lighting (*The Plumber*, Oct. 1).

The Degea Outside Lamp (*J. G. L.*, Oct. 12).

The three articles referred to above all deal with an interesting new development, "The Airostat Burner." This utilizes a clip which partially covers the air-holes when the burner is cold. As the burner heats up and requires more air, however, this clip expands and uncovers the holes, thus letting more air be sucked in and automatically maintaining the most favorable conditions of combustion. It is also suggested that this power of adaptation of the burner leads it to act equally well on widely kinds of gas, such as are inevitably met with in different districts.

Gas Zündvorrichtungen (continued; Druckstoss-gasfernzünder; *Z. f. B.*, Sept. 20; Elektrische Zünder, *Z. f. B.*, Sept., Oct. 20).

This serial article has been dealing in an exceptionally complete manner with methods of automatic ignition of gas depending on pressure-wave devices. The author turns in the most recent installment to the consideration of electrical ignition devices.

The Selas System of Lighting (*G. W.*, Oct. 2).

The Falcon Lamps and Burners (*G. W.*, Oct. 2).

Neue Glühstrumpfe (*Oesterr.-Ungar. Installateur*, July 24).

Un Nouveau Bec Reverse (*Le Moniteur de l'Industrie du Gaz, etc.*, Sept. 30).

Lampanturile Romanesti (*Bursa*, Bucharest, Oct. 3).

Certain varieties of petroleum, including the Roumanian varieties, are not well adapted for illuminating purposes, owing to a tendency to smoke and smell. Dr. Edeleanu, however, is now credited with the discovery that this defect is due to the presence of certain aromatic hydrocarbons which are not removed by the ordinary refining processes. By treatment with sulphur dioxide these substances are got rid of and the defective qualities of the oil disappear.

The Illuminating Engineer

Vol. IV JANUARY, 1910 No. 11

LET IN THE LIGHT

The world was without form and void, and darkness was over the face of the deep.

Darkness and chaos are twin sisters; ignorance, disease and crime are their offspring. Order is heaven's first law; the first step toward order is light.

Are there places in your city that are noisome by day and dangerous by night? Light them up. Spread the light deep and thick. Banish the shadows, and you shall see these foul spots disappear.

Is there a department in your factory which does not come up to the standard in the quality and quantity of its output? Look to the lighting; clean the windows; whiten the walls; put up modern light-sources, and watch the results.

Do you find seemingly needless mistakes in the clerical work of your office? Do you find your own faculties clouded before the day's work is done? Look to your lights. See if they are not hammering the most sensitive nerves of your brain with their infinitely rapid strokes. Would you willingly have a policeman's rattle continually sounded in your ears? Light is a vibration infinitely more rapid, and more rasping to the nerves of the eye when improperly used: look to your lights.

Do you find reading at home these long evenings tiresome? Do you find your eyes burning and your head aching, when you have only fairly begun to read? Look to your illumination. Care for your eyes as well as your stomach: eye-ache is more to be avoided than stomach-ache.

Let in the light of day. Sunshine costs nothing, but the doctor and undertaker always send in their bills.

Light up your home and you will be healthy and cheerful.

Light up your office and you will find half the worries will disappear.

Light up your factory and increase your dividends of dollars and good will.

Light up your city and it will thrive, commercially and morally.

Light up and KEEP *lighted up.*

E. L. Elliott

Some Notes on the Lighting of Factories and Workshops

Views on This Important Phase of Illuminating Engineering by European Authorities

By J. S. Dow.

[Note.—Mr. Dow's article was written without any knowledge of the article on the same general subject, which appeared in our last issue. Any similarity in facts or opinions therefore only shows that there is general agreement on the subject in the two countries.—Ed.]

The value of good illumination in factories and workshops has several times been emphasized by the editor of this journal, and recent publications in Europe have shown that, gradually but quite decisively, conviction on this point is gaining ground. On the occasions referred to it was pointed out that the increased cost involved in securing adequate lighting is usually trifling, in comparison with the improvement in the output and quality of work which might be expected. In many cases doubtless the extra expense might be *nil;* in other words, it might often be possible to secure the needed improvement merely by altering the position of badly placed and useless lights or by equipping existing sources by proper shades and reflectors.

Moral Effect of Good Lighting.

There is also another point of view which was also brought prominently forward by Mr. L. Gaster in his recent Cantor lectures on illumination before the Royal Society of Arts (London)—namely, the importance of the system of lighting from the standpoint of the general well-being of employees. The depressing effect of living in dingy rooms and squalid surroundings or, perhaps, in districts where perpetual mist and cloud obscures the sunlight, is well known, and the melancholy nature of the night watchman's work is proverbial. The lighting of schools and factories may be classed together as of peculiar importance, on account of the fact that in each case we have to do with people living for long periods of time under the conditions of illumination provided. Any relatively small defect in the system of lighting is therefore more important, hygienically than in the cases of premises through which people are constantly passing; though insignificant in itself the cumulative influence of such defects may be more serious.

It is probable that this view of the matter will be yet more emphatically indorsed by the authorities in Great Britain in the future and that special attention will be paid to the preservation of proper methods of illumination in factories. An interesting parallel may be drawn with the growing insistence on the need for good ventilation and pure air. At one time the importance to the nation of preserving standard conditions in this respect was hardly realized. To-day factory inspectors pay careful attention to both these points. Yet, as Mr. Gaster pointed out in the lectures referred to, is not good illumination as much of a necessity as adequate sanitation and pure air?

Illumination as a Protection Against Accidents.

Good lighting in factories and workshops is also important because of its indirect influence in preventing accidents. Mr. Patchell, in a recent presidential address to the Association of Engineers in Charge in London, recently called attention to the need for good illumination in factories for the benefit of machinery. A plant in a badly lighted room, he pointed out, rarely gets the attention it needs, simply because, even when clean, it cannot be properly seen and is no credit to the cleaner. It may also be said that, in the absence of proper illumination, the attendant simply cannot tell whether the engine under his charge is clean or not. Naturally want of cleanliness is apt to pave the

way for a breakdown. Apart from this aspect of the matter it is obvious that machinery in a dim corner may be dangerous in the sense that its outlines cannot be seen and workmen are more liable to get some portion of their anatomy caught in an inefficiently guarded wheel, etc. Occasionally, *e.g.*, in certain varieties of tailoring work, circular saws, etc., the nature of the job makes it difficult to provide any adequate guard. In such cases when the operator frequently has to bring his fingers near to the edge of the saw or sharp cutting edge it is essential that the light should be arranged so that he can clearly see what he is doing. Not only should there be nothing liable to dazzle him, but there should be sufficient and *well-directed* light on the work. It might be, for example, that a shadow coming in the wrong direction would obscure the work and lead him either to spoil the work in his charge or to damage himself.

Proper Light Reduces Mistakes in Work.

In connection with this question of the responsibility of bad illumination for damaged work some remarks in a recent trade publication may be quoted. Here it was estimated that quite 75 per cent. of the mistakes in factories take place after 4 p.m. This, of course, may be partly attributed to the fact that the men are approaching the end of their day's work. They are probably tired, their senses are not so keen and their power of concentration is less perfect. But it is surely not all coincidence that this tendency toward defective work is found to occur between four and six—*i.e.*, the hours in which, in all probability, daylight illumination tends to be replaced by artificial light. Possibly, too, twilight is in any case a trying part of the day in which to work. For the daylight is passing away but the eye has not yet adapted itself to the altered conditions of artificial lighting. Dr. Bell has pointed out how a mixture of the waning daylight with illumination from the yellower artificial source seems to be strangely inconvenient to the eye, and even if daylight is shut out and completely replaced by artificial lighting, the eye probably takes some time to get adapted to the altered conditions.

Importance of a Free Use of Daylight.

It is interesting to observe that most of those who have paid attention to the lighting of workshops and factories have dwelt upon the value of free access to daylight. For instance, Dr. T. M. Legge, the Medical Inspector of Factories to the Home Office in Great Britain, lays stress upon the value of sunlight in rooms devoted to lead processes and other trades which are liable to produce anæmic conditions (*Illum. Eng.*, London, June, 1909, page 373). It is, indeed, very generally admitted that rooms of any kind which are habitually occupied by a number of people crowded more or less closely together, as so often happens in warehouses and factories, are the better for the free access of sunlight on account of its germicidal properties.

A very interesting instance of the recognition by authorities of the importance of carefully considering the lighting of factories is furnished by a recent report on the subject presented recently to the Conseil d'Hygiene de la Seine in Paris (*Illum. Eng.*, London, May, 1909, page 319). In this report again special stress is laid on the value of access of daylight. This point was considered so vital that the possibility of actually forbidding the use of premises of this nature was contemplated. However, it was recognized that this would be unduly harsh, especially as there are regions in the center of Paris where space is so valuable that underground basements must almost inevitably be utilized; special reservations are, however, made regarding the employment of women and children under these conditions.

Methods of Determining the Proper Amount of Daylight.

While referring to the value of daylight it may perhaps be permissible to make mention of the need for better methods of determining whether a room is adequately provided with access of daylight or not. This is a question which has been recently taken up with some energy by Mr. P. J. Waldram in England, though researches were made some years ago by Prof. L. Weber, Professor Ruzicka and others on the continent. Mr. Waldram has found photometry to be of considerable service in demonstrating his conten-

tions in "Ancient Lights" cases (*i.e.*, legal cases in which objection is taken to the erection of an adjacent building on the ground that it obstructs the free access of daylight to an interior, etc.).

A method employed by Mr. Waldram with some success in studying this point has been as follows: He has found that, under all ordinary conditions, a certain constant relation can be shown to exist between the intensity of illumination at a given point in a room and the unrestricted illumination due to the sky outside. The value of this constant depends on many factors, such as the position of a room, its window space, the reflecting power of the wall paper used, etc. But the essential point is that, for a given room, the ratio of the interior illumination at a certain point inside to the free illumination outside is practically constant under widely different climatic conditions. It may, therefore, be regarded as a rough index as to whether the provision of daylight illumination in a room is adequate or not. Mr. Waldram has suggested that an office for which this constant had the value 0.001 could probably be considered fairly well illuminated. In a recent number of the *Illuminating Engineer* (London) he gives a few values of the constants determined for different buildings in London. In ordinary offices the constant was usually near 0.001. In the British Museum reading room it was 0.007. In the Royal Courts of Justice, however, it was only 0.0007 to 0.0022, while on the Woolsack in the House of Lords it was only 0.0004.

Indirect Lighting.

There are several points by which those who have been groping after some definite recommendations on factory lighting have been specially struck. Firstly it has, of course, been invariably recognized that sources of undesirably bright intrinsic brilliancy must be kept out of the field of view of workers. For this reason the report of the *Conseil d'Hygiene* referred to speaks in favorable terms of the system of inverted lighting. Dr. Schanz and Dr. Stockhausen two years ago laid stress on the same point (*Zeitschrift für Beleuchtungswesen*, October 10, 1907), advocating that no source of an intrinsic brilliancy exceeding 0.75 Hefners per square centimeter should be allowed to fall within the range of vision. Mr. Gaster, in the lectures previously referred to, has even suggested that the time is ripe for some definite governmental recommendations on this point (*Journal of the Royal Society of Arts*, London, September 3, 1909).

Indeed, it may fairly be said that the desirability of insisting on this principle is now commonly recognized among all illuminating engineers. We do, however, still await more precise data specifying exactly what ought to be regarded as positively injurious in this respect. The possibility of framing definite recommendations on the question is not to be lightly undertaken even after the valuable work that has already been done on the subject; we may, however, confidently expect that the Illuminating Engineering Society will be able to collect the necessary evidence and furnish more exact data in the near future.

One cannot speak in the same positive fashion regarding the desirability of always using inverted systems of lighting. That this system has much to recommend it is undisputed. At the same time, the matter has been the subject of much discussion at recent meetings of the Illuminating Engineering Society, and there seems to be a well-grounded impression that the method should not be employed indiscriminately and without regard to the special uses to which the interior illuminated will be put. In factory lighting, where large areas have to be illuminated and esthetic considerations are of small consequence, inverted systems will, no doubt, often prove serviceable. Yet even here it is conceivable that in many cases the impression of lack of shadow and "flatness," to which exception is often taken on artistic grounds, would sometimes be objectionable. The psychological effect on workers constantly employed under such a system of lighting might prove worthy of consideration. It is, for instance, not difficult to credit that certain lighting arrangements are naturally stimulating to the mind and keep the worker alert, while others, valuable no doubt to jaded nerves but unsatisfactory in the workshop, have a soothing or positively depressing influence. Bearing these

points in mind one can only remark that at present we are probably wise in abstaining from specifying any particular method of lighting as invariably desirable.

Necessity for Diffusion.

There is, however, good reason to advocate good diffusion of light and the absence of undue contrast or anything in the nature of streakiness. This point was also brought out in the trade publication to which reference has already been made. It was pointed out that any tendency toward "streakiness" in the illumination of factories is especially unsatisfactory on account of the prevalence of vibration. Only a very slight degree of vibration may cause a "flickering" effect when the illumination produced is very badly distributed. But when the illumination is moderately uniform and the inequalities in the natural curve of distribution of the illuminant are smoothed out by the use of suitable diffusing globes or from suitable mat white surfaces, the effect of vibration is trifling or even imperceptible.

Intensity Needed for Various Classes of Work.

Reference should lastly be made to one very vital point in factory and workshop illumination—namely, the possibility of specifying the intensity needed for various classes of work. In framing recommendations on this point a considerable amount of latitude must be allowed. There seems, however, no reason why it should not be possible to agree on a range of illumination suitable for many classes of work. It is very interesting to observe that of all the countries, the legislation of which was studied in the report of the *Conseil d'Hygiene,* only Holland has prescribed a definite order of illumination in workrooms. Thus is the case of certain trades, such as embroidery, knitting, engraving, watch making, etc., and other varieties of work which make special demand on the eyesight, a minimum illumination of 15 bougie meters (roughly 1.5-ft. candles) is specified. Considering that the possibility of fixing any such limit by law has scarcely been suggested in Great Britain as yet, and our ideas as to the order of illumination needed for different kinds of work and how it should be applied and measured, are still somewhat indefinite, it seems remarkable that such precise regulations should have existed already two years ago in Holland.

There are, of course, many difficulties bound up with any attempt to specifiy illumination definitely in this way. One can easily understand the possibility of doing so in the case of work carried out on a horizontal table, and therefore presumably demanding the measurement of illumination in a horizontal plane and at a definite point. But it would seem less easy to say how the illumination on many tools in the workshop should be specified.

Importance of Illuminometry.

The solution of such questions is, of course, also intimately bound up with the limits of accuracy and convenience of the illumination photometer. Even granted, however, that the instruments of the present day are imperfect and less satisfactory than we hope they will be in a few years, their value as a means of preserving a record should be clearly recognized.

When we specify certain conditions of illumination as defective it is often difficult to lead others to think as we do on the matter so long as we base our arguments only on personal impression. The skeptic is always at liberty to declare that he does not find the light bad and that his impression on the mater is as likely to be right as ours. The difficulty, too, becomes intensified when we seek to recall the conditions of illumination on a certain past occasion and have only our personal recollection on which to fall back. Not only is the memory untrustworthy, but one's ideas become remarkably modified in course of time, and what we deemed good illumination a month ago we might condemn to-day.

What is needed, therefore is some means of preserving a record. This a photometer can lay claim to do. In some practical cases we may be anxious to prove that the illumination is only 1 candle foot when it should be 3, or that it is even less than 1-10 of a candle foot. In doing so we need not be greatly concerned even if we granted the possibility of our illumination photometer being 25 per cent. wrong.

The Business Side of Modern Street Illumination

By G. Brewer Griffin and F. H. Dimock.

(*Continued.*)

Since the preparation of these papers we are able by continued observation to give further comparison than that for the four months mentioned on page 412; wherefore the data should be of added value to the engineer and the tabulation of cost of operation is of first interest.

While the extracts first given are public documents and all figures of cost are from public records, the existence of such available data has been a matter of surprise to some of our engineering friends. Their expression of desire for thorough study and analysis of such tabulated results of actual operation suggests that all who have not access to such admirable bookkeeping reports in detail may be interested in such tables and extracts as may be reproduced within the editor's limits.

Through the courtesy of Mr. Alexander Gray, superintendent; Mr. F. E. Tencate, chief electrician; Mr. A. A. Gies, chief clerk, and Mr. George H. Schaffnit, chief engineer, we were afforded opportunity for thorough inspection of the plant, operations and methods of the North Side Light Plant, Bureau of Light, Pittsburgh, Pa.

This was originally a plant of the city of Allegheny, Pa., absorbed in the formation of Greater Pittsburgh by the merger of 1907.

The report for the year ending January 31st, 1909, was its eighteenth annual report, and Mr. Gray has been its superintendent before and since its incorporation with the Pittsburgh Department of Public Works for six years.

Some of our readers may be surprised

FIG. 5.—METALLIC FLAME ARC ILLUMINATION, CITY PARK, NORTH SIDE, PITTSBURGH, PA. PHOTOGRAPHED AFTER DARK, SEPTEMBER 29, 1909.

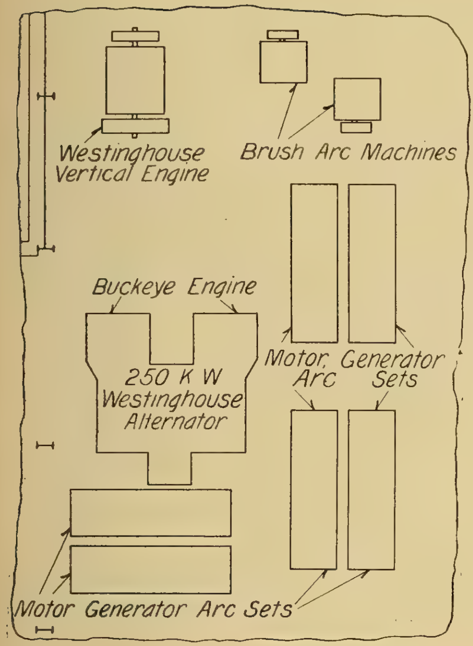


FIG. 6.—PART OF FLOOR PLAN, NORTH SIDE LIGHT PLANT, SHOWING SPACE OCCUPIED BY ARC SETS UNDER OLD SYSTEM.

that a municipal plant should be made a subject of business comparison; and in that very particular the following summary is significant, the emphasis of the last three items being ours:

ELECTRICAL OUTPUT: SUMMARY.

	Kilowatt hours.
Due to arc lighting service	3,050,154
Due to incandescent lighting service.	1,262,300
Total current output for year	4,312,454
Preceding year (11 months)	3,951,653
Increase equals	360,801
Operating expenses per arc lamp, 1907-1908	$46.56
Operating expenses per arc lamp, 1908-1909	46.21
Decrease equals	$0.35

In the closing "Remarks" of his report Mr. Gray modestly refers to this decrease; but, in his place, we should have been tempted to emphasize the third paragraph, which we have taken the liberty of italicizing in the following quotation:

"REMARKS

Owing to the large number of Brush open arc lamps in service and same being expensive to maintain, it is gratifying to this bureau to show a decrease in cost per lamp per year over preceding year.

The city of Pittsburgh, Pa., having entered into a contract for sixteen (16) mercury arc rectifiers of seventy-five (75) light units, which will operate metallic flame arc lamps, a portion of this installation will be in operation about the middle of March, and will further decrease the cost per arc lamp per year.

The entire apparatus comprising this installation will be installed by this bureau."

While we have put the horse before the cart (as Mr. Gray did not), the cart follows:

EXTRACTS FROM THE ANNUAL REPORT OF THE BUREAU OF LIGHT, NORTH SIDE LIGHT PLANT, PITTSBURGH, PA., 1908-1909.

Appropriation for year		$123,485.50
Expenditures were as follows:		
To operating arc lighting system	$72,410.85	
To operating incandescent lighting system	29,819.42	
To operating gas lighting system	85.95	
To arc lamp construction	421.48	
To incandescent lamp construction	134.88	
Mechanical engineer transferred to Pittsburgh office	1,375.00	
Total		$104,247.58
Balance		$19,237.92

A brief statement covers the amount invested in electric lighting system to January 31, 1909:

To extensions made during past year	$556.36
Amount invested February 1, 1908	583,241.86
Total February 1, 1909	$583,798,22

The amount invested, viz.: $583,798.22, is divided as follows:

To arc lighting system	$466,507.01
To incandescent lighting system	117,291.21
Total	$583,798.22

We have seen municipal plants that *didn't* save 10 per cent. of their appropriation; but that's another story.

This plant had been running as equipped at the time of the report of February 1, 1909, for about nine years.

As presaged in Mr. Gray's remarks, the installation of mercury arc rectifiers and

metallic flame lamps was begun in March of this year, *the entire work of installation being performed by the plant's own force.*

For purposes of comparison the electrical equipment of the old plant and details of operation are necessary:

DYNAMOS.

1—250-kw. 2-phase alternator, direct connected to 350-hp. Buckeye engine.
2—500-kw. 2-phase alternator, direct connected to 750-hp. Buckeye engine.
2—145-light 6.6-amp. Brush multi-circuit arc dynamos.
8—115-light 6.6-amp. Brush multi-circuit arc dynamos.
12—60-light 9.6-amp. Western Electric D. C. arc dynamos.
2—37½-kw. Westinghouse D. C. 125-volt generators (exciters).
1—11¼-kw. Westinghouse D. C. 125-volt generator (not in service).

MOTORS.

6—125-hp. 2-phase motors, operating D. C. arc machines.
1—7½-hp. D. C. motor, operating shop machinery.
1—5-hp. D. C. motor, operating storeroom lift.

The methods of accounting and accurate measurement of current render is possible to compare results of real value.

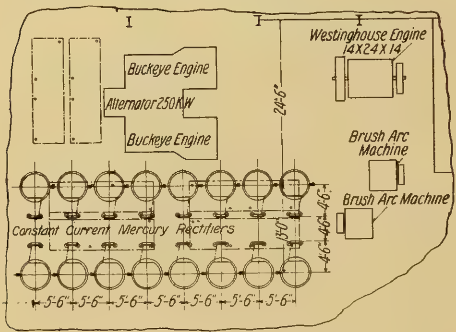


FIG. 7.—THE SAME SECTION OF FLOOR AS THAT IN FIG. 2, SHOWING SPACE OCCUPIED BY MERCURY RECTIFIERS OF NEW SYSTEM.

A glance at the statements of the year 1908-9 shows the manner of charging the classified expense:

ARC LAMP OUTPUT.

1908-1909.	Total hours.	Total No. of lamps.	Arc, lamp hours.	Kw. hours.
February	354	1,553	549,762	274,881
March	339	1,554	526,806	263,403
April	287	1,554	445,998	227,999
May	258	1,554	400,932	200,466
June	228	1,557	354,996	177,498
July	248	1,559	386,632	193,192
August	275	1,559	428,725	214,363
September	320	1,559	498,880	249,440
October	370	1,563	578,310	288,970
November	392	1,563	612,696	306,348
December	422	1,566	660,852	330,215
January	413	1,566	646,758	323,379
Totals	3,906	18,707	6,091,347	3,050,154
Daily average,	10.7			8,334

Highest number of arc lamps in service. 1,566
Average number of arc lamps in service. 1,559

INCANDESCENT LIGHTING SERVICE.

The electrical output of this branch of the service amounted to 1,262,300 kw. hours, an increase of 32,600 kw. hours.

The following statement gives the monthly average and total incandescent electrical output of this station:

1908-1909.	Average max. load.	Average min. load.	Average load.	Kw. hours.
February	134.0	40.7	84.5	122,400
March	112.1	39.8	71.8	116,200
April	96.8	37.1	66.8	98,600
May	92.4	33.9	63.2	95,500
June	84.2	32.7	59.3	86,300
July	73.2	33.3	54.0	81,200
August	72.5	30.4	53.5	81,200
September	101.1	35.4	66.2	98,500
October	114.3	37.6	72.5	110,800
November	125.1	37.4	77.2	113,700
December	134.0	38.0	82.5	128,500
January	138.1	38.1	82.7	129,400
Totals	1,277.8	434.4	834.2	1,262,300
Monthly average	106.5	36.2	69.5	10,520

Integrating wattmeters are installed in incandescent circuits, from which current output is determined, and in the new installa-

RECAPITULATION.

	Total.	Arc only.	Incand. only.	Arc exten.	Incand. exten.
Office labor	$3,825.00	2,660.04	1,114.83	34.69	15.44
Station labor	26,438.49	15,447.80	10,990.69	......	......
Line and Lamp Dept. labor	23,697.30	18,802.62	4,541.01	241.49	112.18
Supplies	43,336.94	31,513.79	11,670.59	145.30	7.26
Repairs	4,788.10	3,502.07	1,286.03	......	......
Office and misc. expenses	700.80	484.53	216.27	......	......
Totals	$102,786.63	72,410.85	29,819.42	421.48	134.88

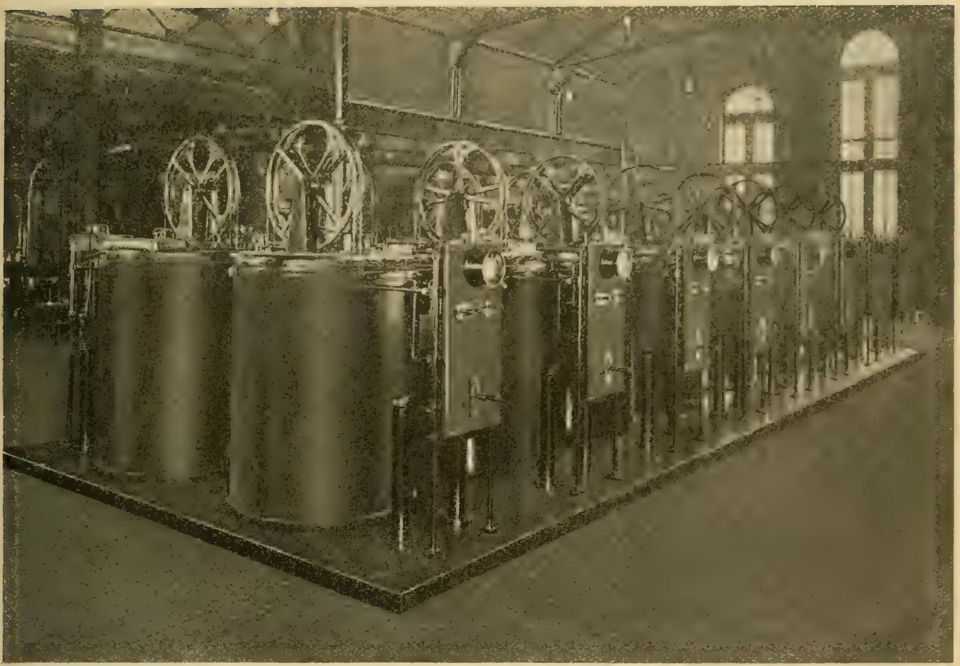


FIG. 8.—BATTERY OF 16 MERCURY RECTIFIER 75-LAMP UNITS. NORTH SIDE LIGHT PLANT.

tion integrating meters are supplied with the mercury rectifiers for metallic flame arcs.

It is to be noted that admirable measures were taken for ascertaining the energy consumption of each class of service, and that the percentage of total output is thus made the basis of charging to each branch of illumination its appropriate proportion of cost.

Under the old system the capacity of the plant had been reached.

During the peak all three of the generators (1250 kw.) might be required, though not generally used, but further extension of any reliable service was impossible and the community was growing. The available floor space of the power house was so utilized that installation of additional generators and converters was impracticable; equally important was the fact that the full boiler capacity was employed, the entire battery of eight boilers being required for supplying the power at full load, and the plant could not be enlarged, as it covered all of the available floor space. To increase the service under the old system meant purchase of ground and the erection of a new plant at enormous expense, and yet more lights were demanded. A situation similar to those mentioned earlier in our discussion existed.

In consideration of the problem thus presented, Mr. A. B. Shepherd, then director of the Department of Public Works, called upon the services of Mr. W. Edgar Reed of Pittsburgh, consulting electrical engineer, who made a thorough analysis of the situation, the plant and all conditions.

As a result of his investigations it was concluded that by the installation of mercury rectifiers as successors to arc machines and the substitution of metallic flame arc lamps for open and enclosed arcs in use, a kinetic saving of at least 30 per cent., together with better illumination, could be effected. In other words, the present service could be better operated at less cost, or extended 30 per cent. in number of lamps served and the whole territory better lighted without increased operating expense.

The illuminating and actinic qualities of the new lamps shown in Fig. 1 are considered remarkable.

It is to be noted that no daylight en-

tered into the exposure of either this negative or the similar ones accompanying this paper. No exposure was made until after darkness. The cluster of small lights in the background shows incandescents on the stone bridge.

The "Business Wisdom" of the new installation may be best judged by the actual figures of operation for months of this year in comparison with those for the same months of last year. In order that the figures be fully understood a brief description of the new installation is pertinent.

While financial conditions did not permit immediate substitution of a new system for the entire arc lamp service, it was determined to install constant current regulating transformers or rectifiers of 1200 lamp capacity.

Under the old system 12 60-light direct-current arc dynamos or motor generators, with total rating of 720 lamps, required 69¾ sq. ft. for each pair and were so grouped and spaced about the 250-kw. generator as to actually occupy about 570 sq. ft. of floor space, and stood on a concrete foundation 7 ft. thick.

These machines were all taken out and disposed of. The concrete foundation for eight of them was raised, slightly extended, increased in thickness by addition of about 10 in. in order to bring it above the surrounding floor and an extension of a narrow wooden platform was provided for the central panels. On this space were installed 16 mercury rectifiers of 75-lamp capacity each, giving a total capacity of 1200 lamps, and these rectifiers were put in practically the same space required for eight motor generator sets of 480-lamp rating, leaving the floor where the other four dynamos of this type formerly stood unoccupied and available in future for additional rectifiers or other machinery.

This space economy is of importance. As metallic flame lamps have been installed the use of the remaining Brush dynamos has been decreased until there are now but six of the ten in use. These machines require much room that could be used for additional generators if the boiler power permitted.

As given in the list of apparatus, the generators of the plant comprise two 500-kw. two-phase alternators and one of 250-kw. operating at 2200 volts constant potential. These generators, when run at full capacity, as formerly, use the entire boiler capacity of the plant. The specifications for bids for the new system provided that it must be so arranged as to be installed without interference with the lighting service in operation, and that the apparatus should be suitable without change for satisfactory operation upon 7,200 alternation circuits or upon other alternators of present commercial construction. It was further specified that not more than 330 watts per lamp (line loss not considered) should be required at the alternator terminals, that the system be such that each of the 500-kw. alternator sets should be able under normal operating conditions to successfully supply to the satisfaction of the director 1200 arc lamps without undue rise of temperature at the alternator, and that, under similar conditions, the 250-kw. alternator should operate at least 450 lamps.

The contract as awarded called for 16 complete units, each comprising one 75-light constant current mercury rectifier, with its appropriate parts, lamps and fittings, and each unit is arranged for operation independent of the others. The entire new system, therefore, provided for operation of 1200 metallic flame arc lamps upon two-fifths of the kilowatt rating of the station, which had hitherto reached its capacity in supplying a maximum of 1566 enclosed and open arcs.

Further description of the units will be given later. At present, this brief glance at the physical arrangement and mechanical provision of power is suggestive of the advantages of space economy in other possibly congested plants.

As now placed, the rectifiers are accessible on every side and the compact arrangement easily permits such attention as required and an admirable wiring plan.

The entire work was done by Mr. Tencate and his assistants. One motor set was first removed, the concrete built up and rectifiers installed, and the process repeated. In this manner there was no interruption of service, the circuits being changed and new lamps substituted on the same plan. The time, labor and supplies necessary were separately accounted for and the entire cost of the work (extending

over March, April, May, June and July) for supplies and labor in making the change was less than $3000.

The first lamps were turned on in the middle of March, 1909; 1049 metallic flame arcs were in operation in June and 1063 in August. These lamps are on 15 circuits, one rectifier being kept in reserve. There has been no trouble. The system has given entire satisfaction and shows marked economy. Notwithstanding operation of a total of nearly 200 more lamps than before the change, and the fact that there are still 640 (or over one-third of the whole system) enclosed lamps of the old type operated by arc machines on 6.6 amperes, the actual operating cost has been decreased. The lamps have shown unexpected life of trim with excellent illumination, and the force of trimmers has been reduced from six men to three, with accompanying saving in use of wagons, etc., as mentioned later in detailed cost of operation for this year.

The main switchboard now carries the integrating wattmeters which measure the output of the rectifiers and a large oil control switch used instead of the plugs formerly controlling the generators and still in place on the first three panels.

(*To be continued.*)

Art and Engineering

The opinion was expressed in a discussion at one of the meetings of the Illuminating Engineering Society that American genius found its expression in works of engineering rather than in architecture; and that whereas our buildings were mere copies and adaptations and meaningless in expressing our national life, our great works of engineering, our bridges and our towering structures, contain distinct elements of art, as well as exhibiting marvelous mechanical skill.

There is no reason, in fact, why a bridge should not be given as much artistic treatment as a steel frame building. Both are primarily utilitarian, and both offer ample scope for the application of structural ornamentation. Even where the structure is of modest dimensions there is opportunity for artistic effect. An example of this is shown in the above illustration. The approach to this bridge is decidedly pleasing, and the general effect is much enhanced by the use of the lamp standards and the decorative treatment of the poles supporting the trolley wires.

The difference between this structure of steel and concrete, illuminated with electric lamps, and the old lattice work wooden bridge with a shingle roof and clapboard sides, generally left in total darkness, but at most illuminated only by the wavering glimmer of an oil lamp, is an instructive object lesson in the progress of science and art.

APPROACH TO NEW CONCRETE BRIDGE, CAMDEN, N. J.

Church Lighting

II

Gothic architecture is like a man with a strong cast of features—it is very easy to caricature. There is no mistaking the fundamental principles on which it is based, even though they may be distorted to the point of grotesqueness, or combined with other styles of architecture.

Fig. 6 shows a method of lighting that is a compromise between the bracket and lamps placed around the capital. Here the pillars are encircled with metal bands half way up, which are made to support both electric and mantle gas lamps. From the engineering point of view this would probably pass fairly well; the distribution should be such as to give a sufficient light on both floor and ceiling, and when the gas lamps are used the glare is fairly well removed by the diffusing globes. This, however, is not the case with the electric lamps, which are apparently used bare in nondescript etched globes, leaving at least two lamps turned toward the eye, no matter from what direction they are viewed.

FIG. 6.—CHURCH OF OUR LADY OF ANGELS, NEW YORK.

FIG. 7.—GREEK ORTHODOX CHURCH, NEW YORK.

Architecturally, the arrangement of the lighting fixtures is open to severe criticism. The metal band and the sprawling arms supporting the lamps break the continuity of the column, which is the prime structural motive. The fixtures in themselves cannot by any stretch of the imagination be called decorative, and proclaim without question the fact that they are an unsuccessful attempt to accomplish their purpose.

Fig. 7 shows still another solution of the problem. In this case extremely massive and ornate chandeliers are suspended over the center of the floor from the roof girders. From the illumination standpoint these go to the opposite extreme from the fault that was mentioned in some of the other cases and give the principal illumination on the ceiling. Architectually, they are entirely too ornate to harmonize with the severe lines of the structure. Unquestionably the central feature of any church is the altar, or pulpit. It is for this that the entire edifice exists. Any means of impressing this fact upon those present is therefore in keeping with the spirit of the place; and *vice versa,* anything that tends to distract from this center of attention is objectionable. These gorgeous chandeliers with their numerous points of light must certainly come under the latter criticism. Association of ideas has a very important part in esthetics. The chandeliers here shown are more apt to suggest a ballroom or the banquet hall than a place of worship.

Fig. 8 is a decidedly modern structure. The slight break in the curvature of the arch, the pointed roof, and the form of the window sash are reminiscent of the Gothic. Here we have the glaring bare lamp in its unmitigated severity. The central chandeliers suggest the artificial spiders that may be found in the toy shops. No extended criticism is necessary. It is simply bad, very bad.

Fig. 9 shows an interior of magnificent

FIG. 8.—CHURCH OF ST. MARTIN OF TOURS, BRONX, NEW YORK.

FIG. 9.—CHURCH OF OUR LADY OF GOOD COUNCIL, NEW YORK.

FIG. 10.—A JEWISH SYNAGOGUE, NEW YORK.

proportions and elaborate decoration; in architecture a cross between the Gothic and the Roman basilica. Two lighting systems are in use—four elaborate and enormous chandeliers suspended from the ceiling symmetrically, and a central dome entirely devoid of ornamentation. The chandeliers are modern adaptations of the old "crown" fixture which was developed in the middle ages along with the Gothic church. These are fitted with a large number of flame gas jets. As the photograph shows, they interfere with the view of the mural decorations, which are unusually fine, and are generally in the way. The central dome is apparently an electrical afterthought, being simply a large conical reflector made up of opal glass and containing a circle of incandescent lamps. By contrast with the elaborate chandeliers surrounding it, it is uncompromisingly ugly and a disfigurement to the place. As a lighting unit it is almost equally bad, producing an intolerable glare to all those seated within range of the lamps. Here again the lighting installation as a whole is a failure.

Fig. 10 shows a church, the architecture of which is essentially Roman in its round arches, but with traces of Gothic decoration and the distinctly Gothic clearstory. The lighting installation shows plain evi-

dences of having been remodeled. The original chandelier was provided with flame gas jets, including a ring of such jets under a silvered glass reflector. Later electric lamps were evidently attached to this ring. Brackets are also attached to the lamps along the balcony. If anything worse than the original chandelier, with its bare flames multiplied by reflection in the mirrors, could be devised it has not been discovered. To make quite sure that even those seated in the gallery get a sufficient amount of direct glare, clusters of incandescent lamps have been placed between each of the capitals of the columns. The installation has about all the faults that could be put into a single scheme, both practical and artistic.

The New "Downtown" Street Lighting in St. Louis

By John E. Tiedeman.

FIG. 1.—TYPE OF THREE-LAMP STANDARD INSTALLED ON BROADWAY.

Before the beginning of the new year St. Louis will have completed and in operation the most extensive, most up to date and most effective street lighting system of any American city.

The work of arousing sentiment in favor of a new lighting system in the business district of St. Louis and carrying the project to a successful completion was placed in the hands of the officers of a voluntary organization composed of merchants and property owners within the district, known as the Downtown Lighting Association.

It had been realized by the merchants and property owners that a new lighting system was badly needed in the business district, and it was finally agreed that some steps should be taken looking to the improvement of conditions.

The new organization began work immediately after the beginning of the present year. Committees were appointed, to which were delegated the duties of making a thorough investigation of all existing forms of street illumination and of devising the proper system adapted to conditions in St. Louis.

After more than eight months of labor it was decided to install an improved form

FIG. 2.—TYPE OF SINGLE-LAMP STANDARD INSTALLED IN DISTRICT, EXCEPT ON BROADWAY.

FIG. 3.—BROADWAY, LOOKING SOUTH FROM WASHINGTON AVENUE.

of arc lamp lighting, and by process of elimination the new magnetite arc lamp was fixed upon as the unit of illumination.

This having been established, a committee was appointed to design a suitable lamp standard which could be manufactured and erected at moderate cost, and which would eliminate the unsightly service loops which had heretofore been an objectionable feature of the arc lamp standards. The new lamp standard called for the fixation of the lamp.

These points having been settled, the entire plans were laid before the Board of Public Improvements of the city of St. Louis for its approval and adoption, so that the maintenance charges would be paid by the city under its street lighting contracts with the Union Electric Light & Power Company. The plans were also placed before the executive committee of the Union Electric Light & Power Company, since it was to undertake the installation.

As soon as these details were determined upon the question of cost was taken up, and it was estimated that the new lamp standards could be manufactured and installed on the streets at a total cost to the property owners and merchants of $30,000. In order to obtain this sum the officers of the Lighting Association made an assessment of $1 per front foot against all of the property fronting on the streets to be illuminated by this system. The response received from the property owners to the calls for the funds was more than gratifying, showing that the movement for a new street lighting system in the business district of St. Louis was a popular one.

Actual construction work on the new system was begun in August last, and every effort was made by the Union Electric Light & Power Company to have as many streets as possible completed in time for the centennial celebration, which began October 4. On that date enough

streets were completed to show what the entire system would be like when completed.

The district illuminated by the new system is bounded by Fourth street on the east, Twelfth street on the west, Washington avenue on the north and Market street on the south, comprising a total of forty-eight square blocks.

Prior to the installation of the new system there were in this district only 138 arc lamps of the old enclosed type, which had been installed ten years previous. Under the plan of the Downtown Lighting Association there are being installed within this district 437 6.8-ampere magnetite arc lamps. These are placed in a uniform manner on all the streets in the district, with the exception of Broadway. This street was not included in the general lighting scheme, but was left to the City Improvement Association, composed of property owners and merchants on Broadway. This association installed on this street 240 4-ampere magnetite arc lamps, the maintenance of which is paid for by this association.

The plan of the Downtown Lighting Association calls for four lamps at each street intersection, one on each corner, and so arranged that two will line up with those on the north and south streets and two with those on the east and west streets. In addition, there are placed two lamps in the middle of the block, so arranged that they are approximately 80 ft. between centers. This gives a total of six lamps per block.

On Broadway the lamp standards are designed to carry three 4-ampere magnetite lamps; the standards are placed opposite each other on both sides of the street, and are approximately 60-ft. centers. This gives a total of 10 standards, or 30 arc lamps per block. The effect of this illumination is exceedingly brilliant, and has transformed the old dark Broadway of old days into the most brilliantly lighted thoroughfare in America if not in the world.

FIG. 4.—TWELFTH STREET, LOOKING SOUTH FROM WASHINGTON AVENUE.

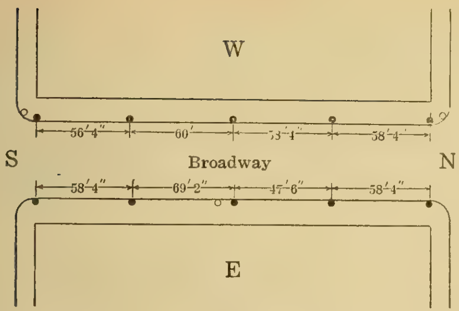


FIG. 5.—TYPICAL BLOCK ON BROADWAY, SHOWING LOCATIONS OF THE THREE-LAMP STANDARDS.

To indicate the magnitude of the new system, it might be mentioned that in the downtown business district there will be installed, when the system is completed, 667 magnetite lamps, of which 427 are 6.8-ampere and 240 are 4-ampere lamps. There are 14 streets illuminated by the single lamp standards and one by the triple lamp standards. In all there are five miles of streets illuminated.

The cost to the property owners in the district, outside of Broadway, was $30,000, and the installation on Broadway amounted to $10,000. The city having agreed to maintain all of the lights, excepting those on Broadway, the additional cost to it will be $30,000 per year, to be paid out of the general funds of the city, while on Broadway, where the maintenance is borne by the merchants, the cost is approximately $9,000 per year.

In order to supply the current for the new magnetite lamps the Union Electric Light & Power Company has installed in its station at Tenth and St. Charles streets three 75-light 4-ampere mercury rectifiers and regulators and seven 75-light, 6.8-ampere rectifiers. In addition to this, it has installed additional generators. The company has also at its own cost done all of the installation of the new system and has furnished all of the new lamps, the only thing paid for by the property owners in the district being the new ornamental lamp standards. When finally completed the total cost of new equipment and construction, it is estimated by Mr. S. B. Way, superintendent of the electrical department of the Union Company, will be fully $100,000, thus making the total cost of the system to the property owners and the Union Electric Light & Power Company in the neighborhood of $140,000.

This new system is permanent and will be in charge of Harry S. Sanderson, supervisor of city lighting.

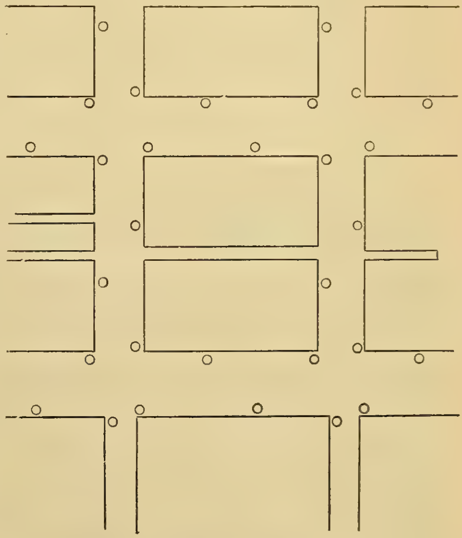


FIG. 6.—TYPICAL BLOCK, SHOWING LOCATION OF OF SINGLE-LAMP STANDARDS.

Practical Problems in Illuminating Engineering

Solution of the Tailor Shop Problem

By M. A. Gurney.

As the room admits of general or even illumination rather than local or independent illumination of certain portions, the general illumination is best accomplished by light units distributed over the ceiling, dividing the area as nearly as possible into equal squares, and a light unit placed at the center of each (see Fig. 3), in order not to detract from the effect of the stucco pieces. These pieces have been considered in the final distribution and placing of the light units.

The length of the room being 40 ft., the width 20, to determine the watts required to give six foot-candles of illumination the following equation results:

$$\text{Watts required} = \frac{\text{area} \times \text{foot-candles}}{\text{constant}},$$

FIG. I.—THE TAILOR SHOP.

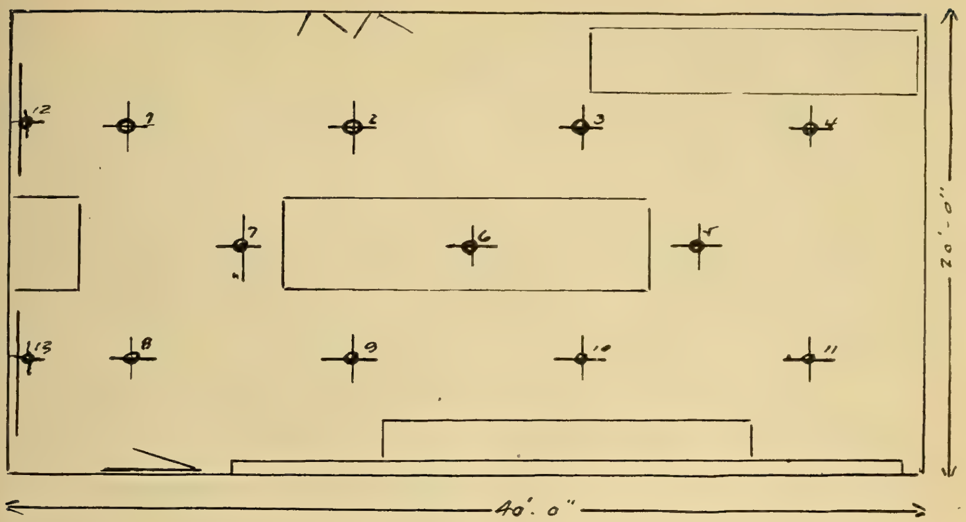


FIG. 2.

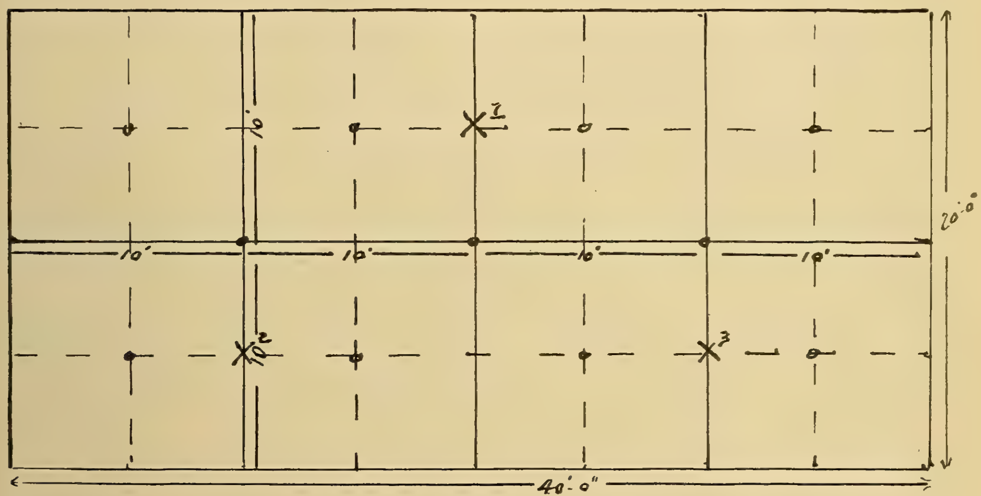


FIG. 3.

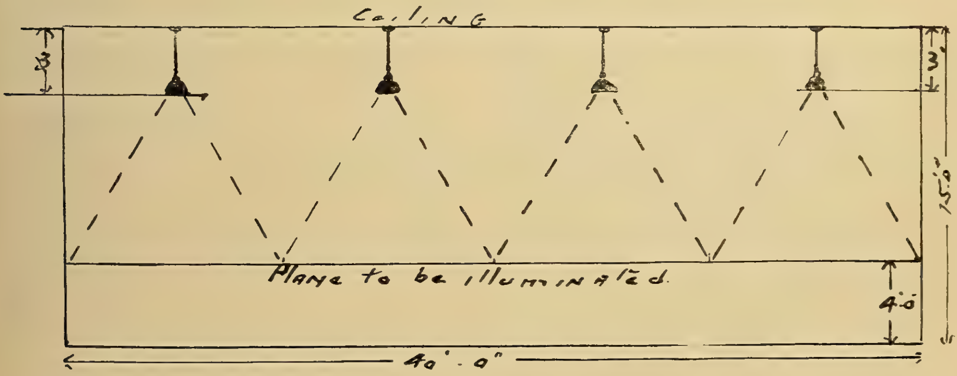


FIG. 4.

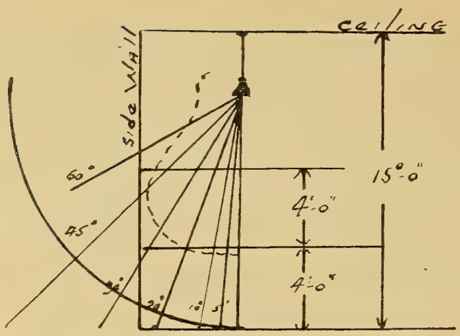


FIG. 5.

$$\text{or } \frac{40 \times 20 \times 6}{4} = 1200 \text{ watts.}$$

in which the constant 4 is known as lumens per watt, or the average foot-candles from one watt per square foot when ceiling is light, with dark walls, and tungsten lamps to be used.

The final distribution and placing of units is indicated in Fig. 2, where units 1, 2, 3, 4, 8, 9, 10, 11 are 100 watt bowl frosted lamps, with I type holophane reflectors hung pendant 3 ft. from ceiling at center of each square, units 5, 6, 7 being 100 watt lamps with I type holophane plane at stucco center pieces at present gas outlets and 3 ft. pendant; 12, 13 are 60 watt bowl frosted lamps, with F type holophane reflectors, hung pendant 3 ft. from ceiling.

As the plane to be illuminated (considering the display table in center of room as the average) is 4 ft. from the floor, then in order to secure even illumination by the use of I type holophane, the units should be hung pendant four-fifths of their distance apart, which will cause the maximum candle-power angles from each unit to meet at the plane (see Fig. 4).

Fig. 5 shows the unit hung 5 ft. from side wall and 3 ft. pendant, indicating that the average intensity does not depreciate rapidly and is practically uniform up to and including the 45 degree angle, or 7 ft. from the floor, the dotted line in Fig. 4 being a characteristic curve when I type holophane reflectors are used.

$\times^1$, $\times^2$, $\times^3$ are test stations and indicate a theoretical average intensity of 5.4 foot-candles, without consideration of a reflection co-efficient.

By this method of distribution switch control of any part of it could be arranged at small expense.

No definite figures for the wiring cost of this installation can be given; yet it is quite apparent that a reasonable figure could be obtained. Forty dollars would cover the initial cost of suitable single light pendants, including lamps and reflectors.

While the maintenance cost would be figured on an 800-hour lamp life basis, yet this may be decreased considerably by employing a pendant fixture having an anti-vibratory device, as it has been determined that such a device materially increases the average lamp life by reducing breakage to a minimum.

A "Home Made" Tungsten Lighting Unit

By Charles G. Mills.

Tungsten lamps possess certain well-known characteristics, such as excellent quality of light, and economy of operation, which make them desirable general illuminants for factory installations; but the liability of the filament to breakage has somewhat retarded their wide application in this direction. It is possible, however, to design reliable installations if the delicacy of the filament is recognized and means adopted for its protection.

Figure 2 shows a complete unit of a type that has given satisfaction for general illumination under adverse factory conditions, and that can be readily constructed by the average tinsmith. It will be noted that instead of the tungsten lamp being rigidly supported by the holder, a spiral spring is interposed between the holder and the supporting conduit to absorb any vibrations of the ceiling which might, if not intercepted, destroy the filament of the lamp. It is wound from brass or steel wire—preferably brass to

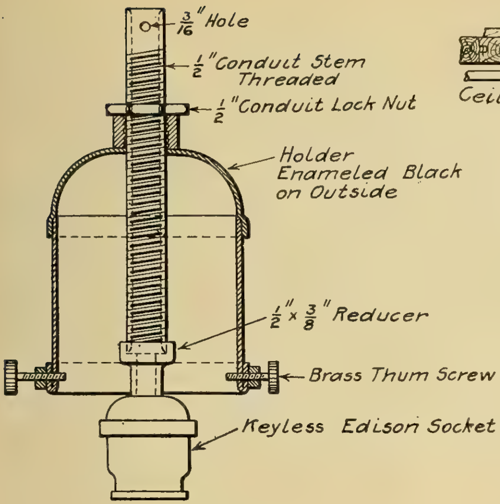


FIG. 1.

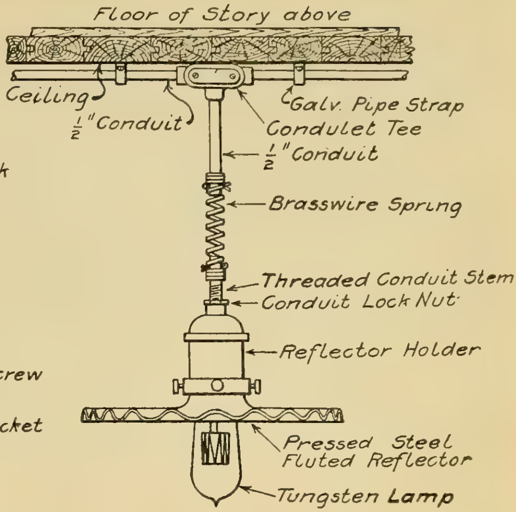


FIG. 2.

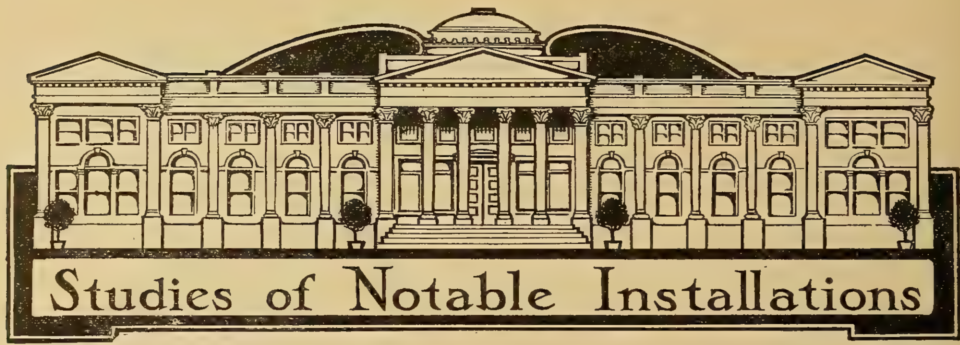
avoid rusting—and has an internal diameter such that it will slip easily over ½ in. conduit. The extreme 4 turns on each end of the spring are soldered together to prevent untwisting, and the spring is supported from the conduit above and supports the conduit stem of the holder. The conduit ends should be very thoroughly reamed as shown, to eliminate the burrs left by the pipe cutter. The springs are wound with their turns close together, and extend, as shown in Figure 1, when the weight of the holder, reflector and lamp comes on them. The selection of the size wire from which to wind a spring for the support of a given unit is largely a matter of experiment, as the material and temper of the wire used affect the properties of the spring greatly.

Figure 1 shows a sectional detail of the reflector holder. It consists of a metallic shell—brass is best, but sheet iron is satisfactory for indoor service—which can be raised or lowered on a threaded ½ in. conduit stem, to adjust the relation between reflector and lamp, to provide for the use of lamps of different wattages. A conduit lock-nut is provided on the stem above the shell to lock the stem and shell in any desired relation. A ½ in. x ⅜ in. reducer—a common pipe fitting—is screwed on the lower end of the conduit stem so that the ⅜ in. keyless socket may be screwed thereto. Within the bushing and the upper collar of the socket is a short ⅜ in. pipe nipple, with its ends carefully reamed, which joins them together

It should be noted that the holder shown in Figure 2 is arranged to accommodate any tungsten lamp with the standard Edison base, and any shade with a holder groove such that the thumb screws will engage therein. Three diameters of shade holder grooves are in common use, viz.:—2¼ in., 3¼ in. and 4 in The 3¼ in. diameter is probably the best one to adopt for a holder such as described, inasmuch as it is sufficiently large to admit the basis of tungsten lamps of large capacity and at the same time many desirable types of reflectors can be purchased with holder grooves of this size.

The complete unit shown in Figure 1 is hung from a conduit fitting, and the branch conductors conveying electricity to the lamp are connected to the main conductors within this fitting. The main conduit is cleated to the wooden ceiling of the factory room with galvanized pipe straps.

When an installation for general illumination has been designed, in which units of the type shown are used, it is but a matter of changing the tungsten lamps originally installed for ones of higher or lower wattage to obtain any reasonable intensity of illumination.



The White House, Washington, D. C.

It is a theory that every American boy hopes some day to dwell in the White House. This expression is an epitome of the entire theory of our government. The White House being the symbol of sovereignty, the American boy representing the citizen, and hope being a mental attitude which can rest only upon possibilities, the statement expresses the fact that the highest office is within the reach of every American born citizen; and if the highest is within reach, so much the more so are the less exalted offices. With this hope springing eternally in the human breast of "Young America," it will be a natural matter of interest to

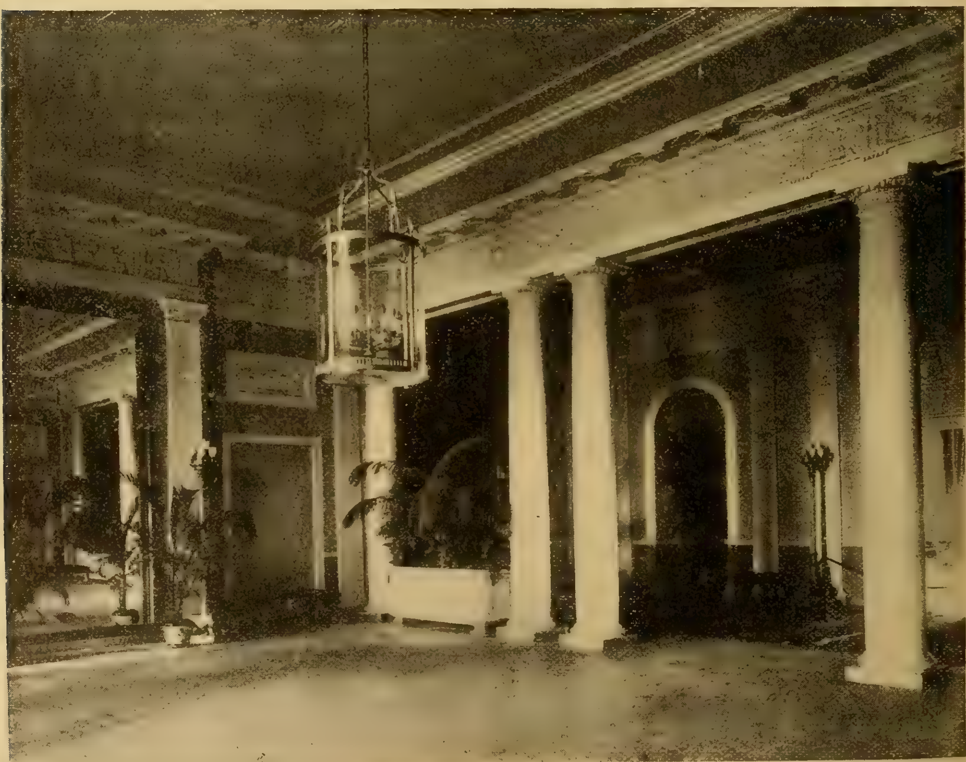


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FIG. I.—VESTIBULE.

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FIG. 2.—EAST ROOM.

him to know how his future home looks, and if he has scientific tendencies, especially how it is lighted. An inspection of the interior through the photographer's camera will therefore be welcome.

The White House is a respectable dwelling of a classic cast of architecture, which at the present time would be called "Colonial." It is dignified, but in comparison with any number of millionaires' mansions of to-day, is decidedly unpretentious and plain, and is about as far as possible from being a palace of the kind that the boyish mind associates with the names of kings, queens, and rulers. While it is to be regretted that most boys will have to be contented with some other residence during their lives, to have a mansion of equal dimensions and magnificence is quite within the reach of any boy who has the money-making instinct.

The White House stands well back from the streets in a small park, and is approached by a semi-circular drive and walk as shown in the illustration on the front cover. As will be seen, there is no lack of illumination at the first approach. Entering from the stately porch you find yourself in the vestibule, shown in Figure 1. The lighting fixture here is an almost exact reproduction of one of the lanterns in the Grand Trianon. This is fitted with imitation candles supporting pointed miniature incandescent lamps. Standards bearing lamps with tulip-like shades will also be observed about the sides of the room.

The most spacious, as well as the most famous room in the mansion is the "East room," shown in Fig. 2. A volume might be written upon the historical social functions that have taken place in this room; but it is with the lighting that we are most interested. The fixtures are massive affairs of metal and cut-glass, the imitation candle being much in evidence,

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FIG. 3.—GREEN PARLOR.

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FIG. 4.—RED PARLOR.

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FIG. 5.—BLUE PARLOR.

although electric bulbs are used within. These fixtures also are more or less exact reproductions of fixtures in the French palaces. The use of these crystal fixtures is in excellent keeping with architecture and decorations, which are a Frenchified form of the classic. The only criticism would be that they seem perhaps a little too massive, they somewhat overbalance and dwarf the architectural features. There should be no trouble in getting sufficient illumination, as there is an opportunity for a number of incandescent lamps behind the crystal glassware, and they must certainly present a brilliant spectacle when lighted. Standards with imitation candles also adorn the corners of the room, as shown.

Beside this state parlor there are three other parlors, each of historic renown. These are known by the prevailing color of the decorations.

Figure 3 shows the "Green parlor." If the furnishings are intended as a symbol, this room must be provided for the reception of the office-seeker having no political "pull." The lighting fixtures again are close adaptations of the French, both in the crystal chandelier and the side brackets.

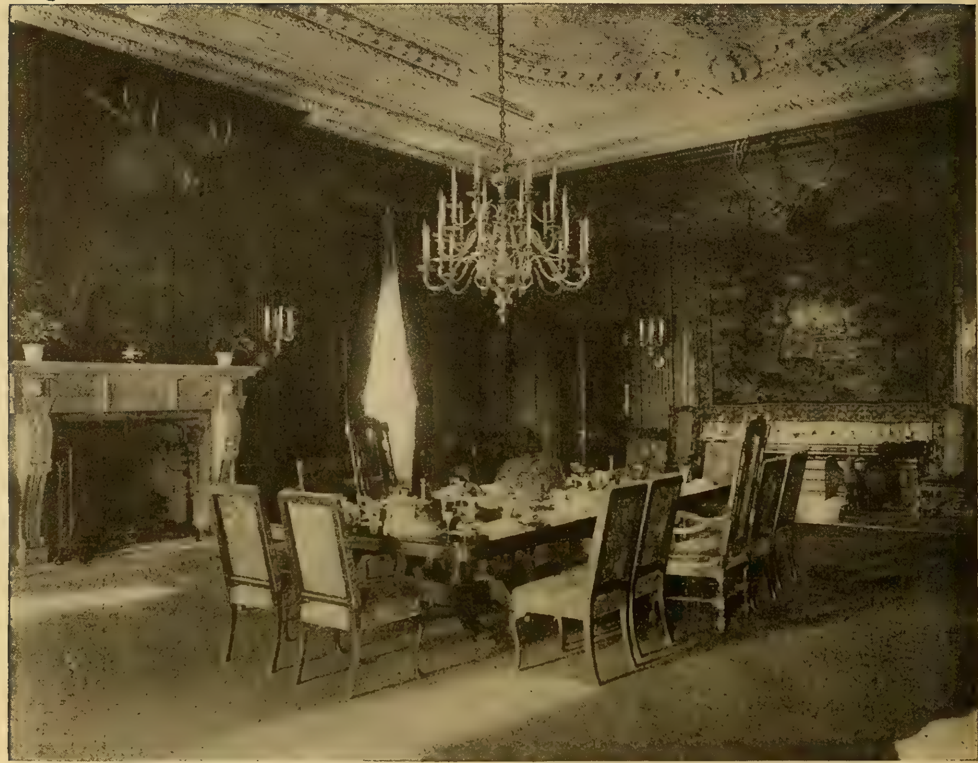

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FIG. 6.—STATE DINING ROOM.

Figure 4 is the "Red parlor," perhaps specially decorated for the reception of the Western callers upon the executive. Again the crystal fixture of French design greets us, but,—let us be thankful,—is free from the distorted imitation candles just mentioned.

Figure 5 is the "Blue parlor," through which doubtless the office-seeker makes his exit after his official interview. The lighting fixtures here are still adaptations of the French, but with the absurd combination of an imitation candle with a round, frosted incandescent lamp. This is a breach of the principles of decorative art, which has often been referred to in these columns, and it is painful to find it displayed where it may be considered representative of American taste and culture.

Figure 6 shows the state dining room. The candle fixture still holds sway, but in this case without the glass ornamentation. While it is an evident adaptation of

FIG. 7.—SECTION OF PRIVATE DINING ROOM.

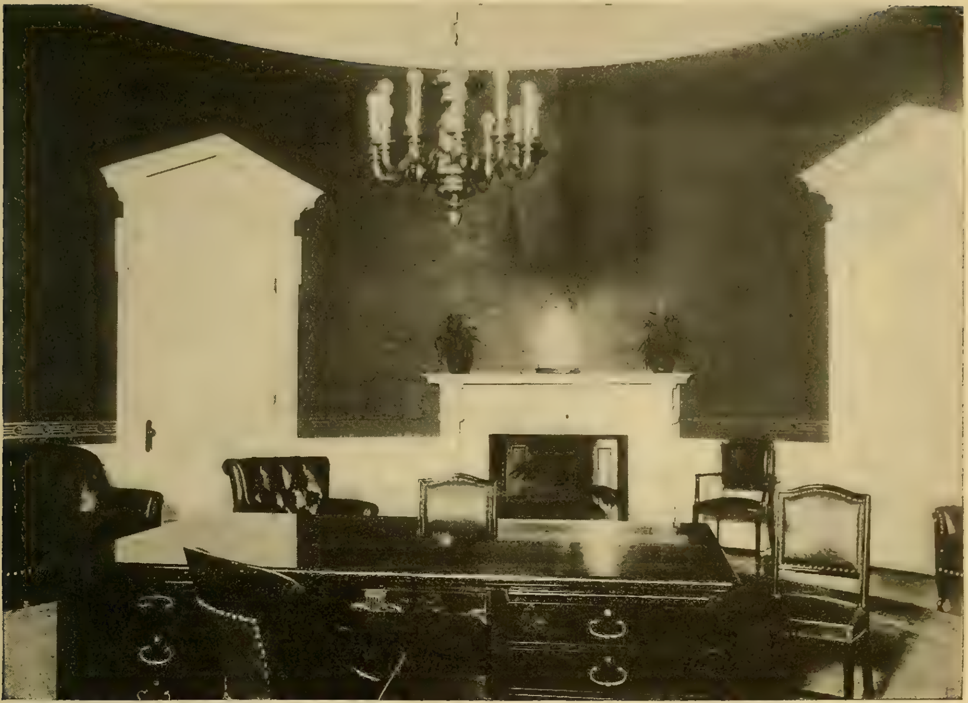

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FIG. 8.—PRESIDENT'S PRIVATE OFFICE IN NEW OFFICE BUILDING.

a French design, the work has been well done and the form of the candle imitated as closely as possible.

Figure 7 is a view in the private dining room showing only the wall brackets with their imitation candles on either side of the mantel.

Recently a considerable extension to the mansion has been made for strictly office uses. Figure 8 shows the private office of the president in this addition. Illuminating engineering was certainly not called into requisition for the lighting of this room. The central chandelier has the absurd round lamp imitation candle combination before mentioned, and the light on the desk must be exceedingly poor. The humble workman may therefore have one thing better than the president, and that is the light by which he writes, or reads his evening paper.

Such is the lighting of the best known and most important residence in America. If you were president would you have it any different?

In general the lighting of the White House is neither better nor worse than that of the generality of government buildings; it is simply conventional and commonplace. In that part of the mansion devoted to domestic and social use no very serious objections can be raised. In the recent additions devoted to official business, however, the case is different. There is no excuse here for any but the very best that modern science can produce, and the installations put in are very far from this standard.

Whatever may be said of its general advantages, there can be no doubt that a popular form of government is sadly inferior to the monarchial form in several ways, one of which is the direct promotion of science and the arts. These have flourished in our country as a result of private initiative; so far as the direct influence of the government is concerned, we might as well be without one in these matters. Meanwhile, personal freedom will develop these along its own lines, and after they have been sufficiently developed they will at last filter into government use.

Fixtures and Accessories

The New Art in Fixtures

A recently published work on "The Decorative Periods" starts out with the proposition, which is apparently assumed to be axiomatic, that "all that is good in decoration is old; what is new is not good. New English is slang. The new in art is vulgar." There is no single word to characterize a statement that is self-evidently false; if there were it would fit this statement. New English is not necessarily slang. The term "illuminating engineer" is new, not being specifically defined in any of the late dictionaries, but it most assuredly is not slang. All languages are continually growing by the addition of new words and phrases necessitated by the progress in science and the arts. So great has been the recent growth of this kind that it has almost formed a new language. A chemist or electrician of the present time might readily converse or write in language that, while perfectly good, intelligible English to himself, would mean practically nothing to the layman.

All decorative art is based on elementary scientific facts, and grows and changes with the progress in their discovery and use. There was a time when each of the "decorative periods" was a new art. The Greek, Roman. Byzantine, Gothic, Dutch, English and French periods all had a day of origin and a time when they were new. To fall back on the saying that there is "nothing new under the sun," and that all the different systems of decorative art are merely different combinations of old elements, is a mere sophistry. A new combination of elements for a new purpose, or to express a new idea, is as distinctly new as the discovery of a new principle itself. It is upon this fact that the patent laws of the world are founded. That the new is, *ipse facto,* vulgar cannot be maintained by argument or fact. The statement is as abhorent to the artistic conception as the dogma of the predestined damnation of infants is to the religious sentiment.

The esthetic value of decorative art depends upon two things: novelty and association. That which is perfectly obvious, either because it contains only the most elementary principles, or because of a familiarity that has rendered it trite, can never appeal to the esthetic sense. A square table supported on four square legs is not a thing of beauty, even though it may be stained black and bear the proud title of "Mission," or "Arts and Crafts"; it may possibly have some esthetic value from association, if it serves to call up any of the emotions which would be produced by reading the history of the early Spanish missions on the Pacific Coast.

In the preface of the volume referred to the statement is made that "Decoration to be good must be consistent; to be valuable it must be historic." It is seldom that two statements so widely apart in their expressions of truth are found in a single sentence. The first statement is the very basis of all applied or decorative art; but the second is a mischievous fallacy, at least when taken in its literal sense. Had this latter statement always been followed to the letter there would be nothing historical in art to-day beyond the aboriginal and primitive forms. The art which expresses the sentiments and conditions of to-day is the historic art of tomorrow. Decorative art in fact is divisible into periods only for the reason that the progress of civilization has proceeded by pulsations or epochs. The historical

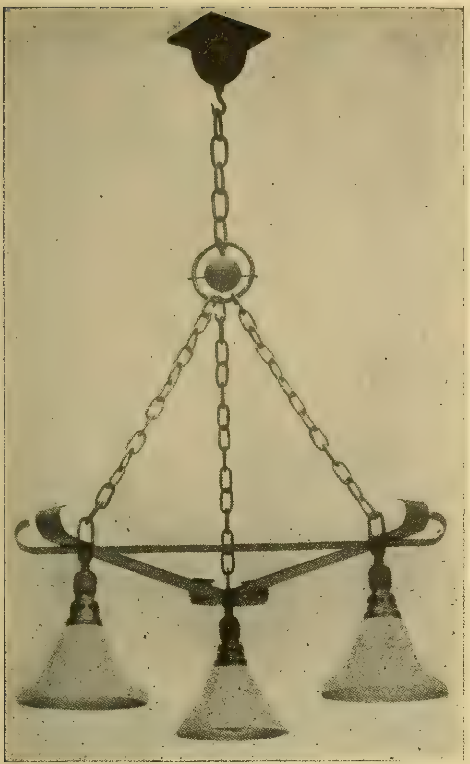


FIG. 1.

period, whether in the political, material or artistic development of a nation, has its beginning in the originality and force of some individual genius. Simplicity and strength therefore characterize the beginning. The original idea then spreads through followers and pupils, and develops by the expansion and accretion of other ideas. Then, as the original idea and the earlier additions lose their novelty, development runs into mere elaboration, which finally degenerates into distortion and the use of wholly adventitious elements. Thus every period of applied art, whether in architecture or decoration, is characterized by an early period of strength and freshness of conception; an intermediary period of refinement and development of the original idea; and lastly a period of degeneration through superfluous and meaningless elaboration.

Reproductions of past forms of decorative art, taken from the period of their greatest refinement, are valuable for their historic interest and possess the esthetic value of association. Manifestly, the reproductions should be as faithful as possible to the original, otherwise they assume that most frequent and obvious quality of vulgarity in art—anachronism. A shining example of such vulgarity is the reproduction of a Roman lamp with a modern electric light taking the place of the oil flame, or a structure in the form of a torch with imitation candles stuck in the end.

The authors in the work referred to state in the third paragraph: "From the beginning art has always simulated nature." The manner in which the various forms or phases of nature will be simulated in decorative art will naturally depend upon the general attitude of civilization toward natural phenomena. Until recently all of the basic natural forms entering into decorative art have come down

FIG. 2.

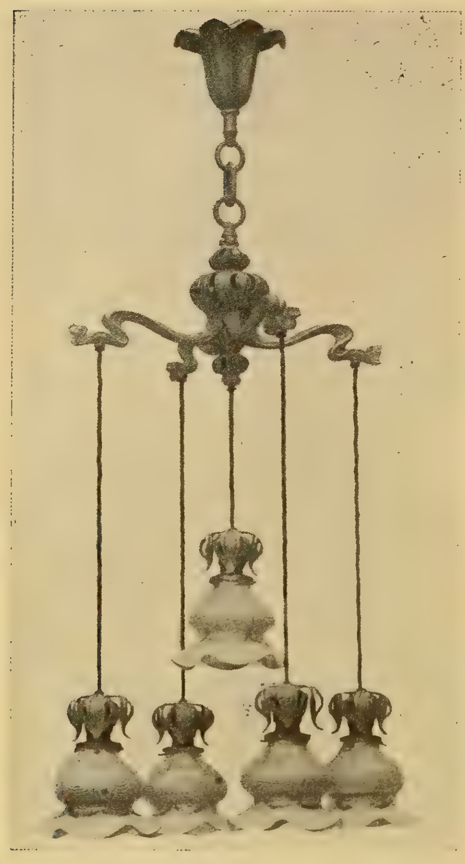


FIG. 3.

from the remote times of Paganism, when nature was conceived to be ruled by and be the personal expression of a large number of gods and demons. This view has been entirely obliterated in modern civilization by the ascendency of science. It would be naturally expected, therefore, that the simulation of nature in modern decorative art should express radical differences of feeling.

A beginning for such a modern artistic period has been made and is known as the "New Art," or in its French form, *Art Nouveau*. This modern school takes a broad and comprehensive view of nature, drawing indiscriminately from all sources, wherever grace of line and form may be found. The pagans' view of nature singled out a few forms which had special religious significance and conventionalized them to the greatest possible degree in order to simplify their use. The new art retains the natural forms as nearly as possible consistent with the mechanical details of structure.

Thus far this new art has made little progress in America. A canvass among the leading fixture manufacturers of New York disclosed the fact that in not a single instance was there any attention being given to developing fixtures along this line, the reason assigned being a lack of popular demand. New York, however, is not by any means the whole of the United States, nor even its final arbiter in matters of art. The West has shown a far greater disposition to seriously study the newer artistic motives, both in decorative art and in architecture. A catalogue of fixtures recently issued by a Western manufacturer contains a number of examples of new art designs, which form at least a decidedly creditable beginning.

Fig. 1 shows a chandelier which may be properly classed as "New Art," for the

FIG. 4.

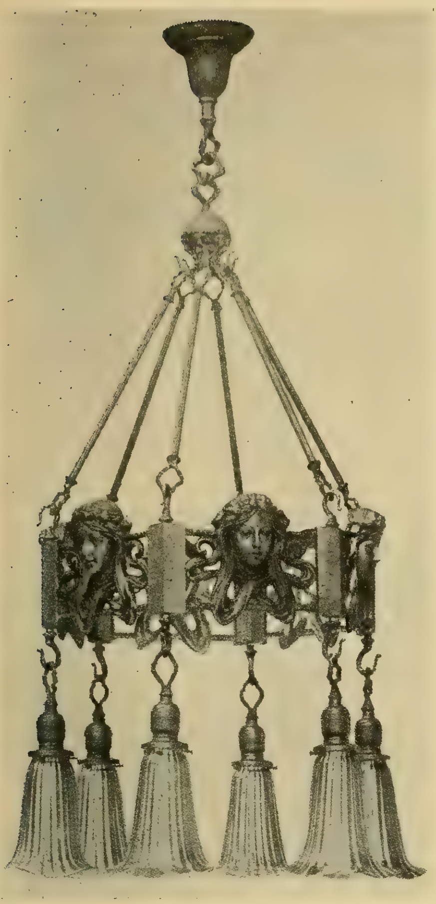


FIG. 5.

reason that it is a decided departure from the designs of all the previous periods. The construction is almost in the lowest terms of simplicity, and yet there is sufficient deviation from the purely mechanical to give it an artistic feeling. The ball in the center of the supporting ring, however, has no excuse for being and is therefore a blemish. The chain here is the actual support, and therefore has an evident purpose. This is worth noting by reason of the fact that chains are not infrequently used as mere draperies, being attached to the ends of the arms and at some point on the central support higher up, falling loosely between these two points, and thus showing their absolute uselessness.

Fig. 2 exhibits a somewhat different mechanical construction, which is also extremely simple but effective. This simulation of nature is found only in the curve of the tubes carrying the electrical conduits, which are approximately catenaries. The catenary is the curve which a flexible body, like a rope or chain, takes between two points of support. The ring which holds the light-sources is the simplest mechanical construction that could be used for the purpose. The fixture as a whole is an elementary demonstration of the fact that the laws of mechanics must be observed not only in truth, but in a manner apparent to the eye, in order to produce a satisfactory artistic effect.

Fig. 3 contains a much greater amount of decoration in the form of natural curves. All of the lines are in excellent proportion, and the spirit is well carried out in the form and coloring of the globes. The flexible support for the lamps is a distinct addition to the general effect.

FIG. 6.

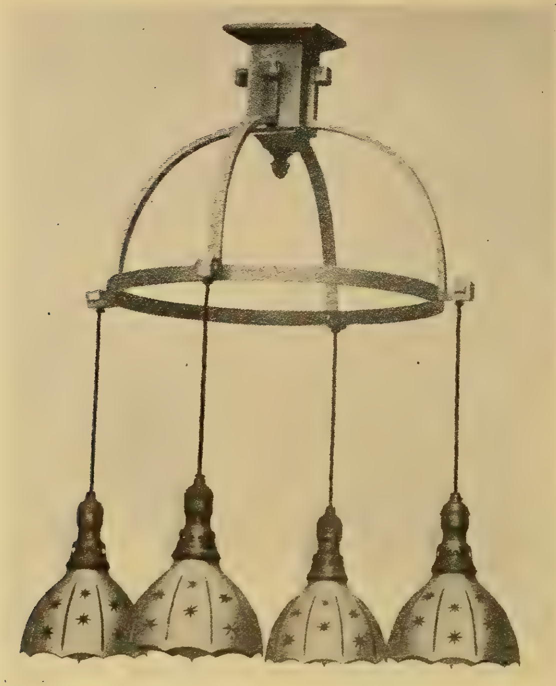


FIG. 7.

Fig. 4 is another expression of the same general ideas. The curves have all been harmoniously blended, and the general proportions are satisfying to the eye. While the curves in both these examples are free and graceful, a careful analysis will show that the actual lines of stress are in accordance with good mechanical construction, hence their satisfying effect.

Fig. 5 is an elaboration of the motive. It is particularly noticeable that the faces forming the chief feature of the decoration represent the actual, living American girl, instead of the totally inane, classical "female figure." The art is therefore in the highest and best sense historical. Should this fixture be brought to light a thousand years hence the face would give a fairly clear idea of the American type of feminine features of its period. The link-and-hock method of support for the lamps and shades gives the necessary freedom from rigidity.

Fig. 6 shows the use of some of the most irregular and unconventional curves found in nature, the combination being thoroughly consistent. Notwithstanding this irregularity in the way of deviafrom modern curves, the motif is decidedly different from the Rococo work which is characteristic of one of the French periods. The latter meant nothing, having no apparent simulation to any natural form, whereas the design here shown at once suggests the irregular forms of roots or tangled branches.

Fig. 7 is a much simpler form, but distinctly characteristic of the new art. The use of the flexible cords instead of tubes for support is noteworthy. The mechanical strength and correctness of the fixture are also apparent.

Theory and Technology

Plain Talks on Illuminating Engineering

BY E. L. ELLIOTT.

NUMBER XXIV.

INDUSTRIAL LIGHTING: GENERAL VS. SPECIAL ILLUMINATION.

In the last issue we were discussing the subject of general vs. special lighting for industrial use, and made the statement that effective illumination depends upon physiological vision quite as much as on mere physical considerations of light. Intensity of illumination on the objects seen is only one of the factors upon which vision depends. Illumination might be entirely satisfactory, judged by this alone, and be highly unsatisfactory in actual use. Such, for example, would be the case if a bright, unshaded lamp, like a tungsten, were placed near the working plane in full view of the eyes.

Some very interesting facts along this line were brought forth in Mr. Marks' paper on "Factory Lighting," presented at the recent Illuminating Engineering Society convention. This paper gave the results of illuminometer measurements in a large typewriter factory in which special lighting was used. The rather astonishing fact was brought out that in many cases the artificial lighting provided was far in excess of the daylight illumination. While no opinions from the workmen are recorded, it is hardly likely that a single one could be found who would prefer the artificial to the daylight illumination.

WHY IS DAYLIGHT BETTER THAN ARTIFICIAL LIGHT?

The very important question in illuminating engineering then arises: why is daylight of a much lower intensity a better working illumination than artificial light? The first and most important point of superiority in daylight is undoubtedly its perfect diffusion. In this respect all artificial light sources and systems for diffusing their rays are hopelessly inferior to natural illumination. Even the best methods of indirect lighting are so far inferior as to be of questionable advantage, especially where a considerable degree of intensity of illumination is required.

The second difference is probably in the quality of the radiations; those from artificial light sources containing a much greater proportion of invisible waves on either one or both ends of the visible spectrum.

Another point of superiority of daylight is, that under all ordinary conditions it is directed light, *i. e.*, the preponderance of light is from some one direction, and thus produces the perspective, or relief, which is so essential to vision. No matter how large an extent of glass is used in a building, or whether it is on side walls or roof, the light will still in general be directed light, for the reason that it comes from a single source—the sun. It is a simple matter to produce artificially a shadowless illumination, but this is far from being the equivalent of daylight; and the very fact of its being shadowless is in itself a serious fault.

Whether general or specialized lighting, or a combination of both is used, the aim must of course be to eliminate as far as possible the qualities which injuriously affect the process of vision. While a number of these effects have been indicated

in describing the superiority of daylight, a more definite examination of these qualities will be of use.

INHERENT FAULTS OF GENERAL ILLUMINATION.

Let us first consider the two methods of general illumination, viz.: direct and indirect. Except in unusual cases a number of units will be necessary in order to secure the requisite intensity throughout the given space, or over the given working plane. In general factory conditions, moreover, the height of the ceiling will necessitate placing the units at a correspondingly short distance above the eyes. The unavoidable result is the location of perhaps a large number of units, so that they are in the normal field of vision, *i. e.* the field that would be encountered by the observer looking straight ahead. This means that there will be a corresponding number of bright points upon the lower half of the retina, which will interfere to a greater or less extent with the perception of the other details of the field. In other words, the objects below the lamps, which are the things desired to be seen, are less clearly visible on account of the eyes taking in the bright points represented by the light sources themselves. Herein lies one of the great differences between artificial and natural lighting; only in the rarest cases will a workman stand facing a window, but in a room illuminated with a number of artificial sources it is impossible to avoid facing them to a greater or less extent. Even when the eye is not directed toward the light sources the upper eyelid, being highly translucent, offers only a partial protection against these bright points.

It would doubtless be possible in many cases to so arrange machinery or benches that the operatives could all face one direction, in which case the light sources could be provided with reflectors made opaque on the side facing the workman, and thus remove this serious objection. Such an arrangement would also remove another of the objections to direct lighting, viz., the numerous cross lights, with their attendant multiple shadows produced by the different sources. So far as we know very little attempt has been made to use this method, but it is certainly worth careful consideration.

The necessity for as complete diffusion as possible by the different units by means of some sort of diffusing globe has been sufficiently dwelt upon to need no further argument here. Not only should globes having a high degree of diffusion, such as fairly dense opal glass or heavy etching be employed, but they should be of as large a diameter as possible consistent with mechanical conditions.

INDIRECT LIGHTING.

Indirect lighting is of two kinds. First, where the entire ceiling is kept white and used as the reflecting surface; and second, where a special white reflector is provided immediately above the source; the light in each case being projected upward by a suitable opaque reflector placed below the lamp. The first method has the rather serious practical objection of being very wasteful of light, and of requiring a frequent renewal of the white coating on the ceiling in order to maintain a definite degree of reflection. The second method reduces the amount of reflecting surface to a comparatively small area which must consequently have a proportionately higher intrinsic brilliancy, and therefore approaches more or less nearly the direct lighting unit with a large diffusing globe.

Physiologically, indirect lighting of the most complete kind, *i. e.,* from the entire ceiling, has the fault of giving almost a completely shadowless illumination, and is undoubtedly trying to the eyes, at least where a considerable degree of intensity is required. Indirect lighting is probably best adapted for the production of a moderate degree of general illumination where localized lighting is to be used for accurate vision.

LOCAL OR INDIVIDUAL LIGHTING.

In specialized, or local lighting, each operator has a unit to illuminate his particular field of vision or region of work. With this system the advantage of a directed light is frequently carried to such an excess as to overbalance the advantages. The relief, or perspective, is unnaturally exaggerated by the comparative depth of the shadows.

These inherent faults may be generally reduced by giving the light the most ad-

vantageous direction possible—simply hanging up an electric lamp with a reflector near the work is by no means a generally satisfactory method of providing special illumination. In most cases the lamp with its reflector should be attached to some rigid support so jointed that any desired direction can be given to the rays.

The question of diffusion must also not be lost sight of, even in case of special lighting. A diffusing reflector, such as aluminum with a brush finish, or the pressed steel shades coated with aluminum paint, are much preferable to tin or any other polished surface; and a frosted lamp bulb in addition will still further improve the illumination.

Direct reflection from polished or oily surfaces is another of the faults of special lighting which may become very serious. This can generally be avoided by using the rigid support mentioned and properly placing the lamp. The use of the frosted bulb and diffusing reflector also tends to prevent troublesome reflections. It must be remembered that the injurious effect of such reflections does not depend upon the total quantity of light reflected, but upon the brightness of the surfaces seen by the reflected light. A small spot of oily or highly polished surface which would give an actual image of the lamp filament would seriously interfere with the general distinctness of vision, as well as being irritating to the eye.

COMBINATION GENERAL AND SPECIAL LIGHTING.

A point upon which illuminating engineers are still of different opinions in the case of special lighting is whether it is better for the eyes to have a fairly high intensity of general illumination, or a very low intensity. At first thought, from theoretical considerations, it would appear that a general illumination of sufficient intensity so that the eye in looking away from the specially illuminated field would not need to make any considerable readjustment would be the better, it being a familiar fact that the eye requires an appreciable amount of time to adjust itself to a given intensity of field. On the other hand, it is also a known fact that when the eye looks into a dark field all the muscles are entirely relaxed, which is the condition of complete rest. When looking at a highly illuminated special field, especially one close to the eye, as is usually the case in fine mechanical operations, the muscular parts of the eye are contracted to their full tension. To occasionally look into a field that is dark, without any attempt to see any of the objects in it, which means no effort of the eye to focus itself, gives complete relaxation and rest for that time. It is probable that the result of such a condition is much more conducive to general eye comfort than the higher intensity, which naturally tempts the eye to focus itself for vision. At all events, in providing general illumination where special illumination is used on the actual working field, the greatest care must be taken to remove glare. The semi-indirect methods of lighting are especially adapted to such purposes.

PHYSIOLOGICAL EFFECT OF COLOR

The color of light from different artificial sources has heretofore been considered of importance only in those cases in which it was necessary to distinguish the colors of the objects illuminated. With the greater divergence of color in the more recent light-sources, and the greater knowledge of the physiological effect of radiation in general, the importance of considering the color of light-sources on purely physiological grounds has become a serious matter. In fact, it is now necessary not only to study the effect of the visible radiations, but the invisible radiations as well. Dr. Steinmetz has admirably summarized the case by pointing out that in general the effect of fatigue upon the eye is simply a question of the energy imparted to it by the radiations received. As the blue end of the spectrum possesses much less energy than the red end, light of this color is less fatiguing to the eye. As the blue, however, produces a less visual effect than the yellow, this effect is thereby somewhat counterbalanced; yellow being the most powerful in stimulating vision, it follows that from the yellow to the blue is the least fatiguing part of the spectrum. This is simply an explanation of the long recognized fact that green light produces the greatest amount of ease to the eyes.

Illumination and Industrial Accidents

The Fidelity and Casualty Company of New York have recently issued a pamphlet on the "Prevention of Industrial Accidents" which is probably the most complete and valuable treatment of the subject that has ever appeared in print. The long experience and practically unlimited facilities which this company has for gathering statistics enables it to treat the subject in an extensive and authoritative manner. On the general causes of industrial accidents insufficient lighting is placed first. On this subject the authors make the following statement:

> Statistics show that the greatest number of accidents occur during the months of diminishing light. Dirty windows and insufficient artificial illumination often make conditions much worse than they need be.
>
> Great improvement in illumination may be had by whitewashing the walls of a dark room at least once a year. This also saves much on the cost of artificial illumination.

To one who is at all familiar with mechanical operations, and the methods of artificial lighting which are frequently used, the general truth of this statement will cause no surprise—or rather the surprise will be that many more accidents do not occur. This is particularly true in the coarser kinds of industrial work, such as iron works, saw mills and the like. It is only within comparatively recent times that it has been possible to adequately light such places artificially. It was but a short time ago that the workman had to carry his lamp about with him, as did the pedestrian before the days of public street lighting; and the smoky, ill-smelling "torch," an oil lamp with a solid round wick and no chimney, has even at the present time not entirely disappeared as a workman's illuminant.

To leave any sort of an industrial plant in such a degree of darkness as will in any way contribute to accident is to-day a clear case of criminal negligence, and should be so considered by the courts in cases of claims for damage. The newer types of arc lamp, the mercury vapor lamp, and the high pressure gas systems have made it easily possible to provide a general illumination that will afford as great a measure of safety to employees as daylight.

The introductory paragraph of the pamphlet quoted is the statement of a thoroughly proven fact, which by itself should be sufficient to insure the best of artificial lighting in every industrial plant:

> Not only the safety of workmen, but the maximum output of the plant are promoted by making the physical surroundings of the workmen as comfortable as possible. Plenty of light, good air, safety and comfort pay in a financial sense.

Experience has shown that a sufficiently high degree of intelligence to insure the proper care of employees cannot be assumed as an invariable rule, and hence statutory provision must be made to further safeguard the workman. Here is the statement of a fact based upon statistics from which there is positively no escape. Unquestionably, therefore, the illumination of industrial plants should be regulated by law.

Architecture and Illuminating Engineering

While we have discussed this subject in its various phases several times before,

the last word has by no means been said, nor will it have been said until the profession of illuminating engineering is as fully recognized by the architectural profession as is electrical engineering or construction engineering.

We laid down the proposition in our last issue that if the illuminating engineer expected ever to be thus recognized he must show his faith by his works. To this end two conditions must be observed: first, the illuminating engineer must be an engineer in fact, as well as in claim, *i. e.,* be capable of producing the most satisfactory illumination for a given purpose at the minimum of expense; and second, he must not assume to dictate or advise beyond the limits of his technical knowledge and skill. There is no denying the fact that these two conditions have often been transgressed in the past. In many cases those have assumed to give professional advice on illuminating engineering who had no valid claims to either special technical knowledge, skill, experience or judgment in the matter. Such unfounded claims have been put forward from a number of causes; sometimes for the purpose of selling some particular lighting device, at other times to promote the interests of the company furnishing the illuminant, and again from mere overzealousness on the part of those who thought they had found a royal road to a profession. In rejecting such claims the architect was acting within his rights and fulfilling his duty to his clients.

It does not follow, however, that because some have assumed the title of illuminating engineer who had no just claims to it, that there are no illuminating engineers. Even with all the precautions thrown about the title by legal enactment, there are still many "quacks" ready to give worthless advice under the professional title of the physician. An architect can no more consistently reject illuminating engineering *in toto* than he can reject any other of the branches of engineering because there are incompetents among those practicing it. While there is much yet to be learned on the subject of illumination, and while even the oldest of illuminating engineers have no large fund of accumulated experience to draw from, the fact remains that there are a considerable number of illuminating engineers who are conscientious and thorough students of the subject, and whose opinions and advice are of positive practical value.

On the other hand, the subject is one which has been comparatively little studied by the architect in general, as is shown by the numerous cases of bad installations, and equally clearly shown by the methods, or lack of method, which characterizes their work. There are very few architects who possess personally, or in their organizations, the degree of illuminating engineering skill which is possessed by even the less experienced illuminating engineers.

It is decidedly to the architect's personal advantage, and a duty which he owes to his clients, to advance the practice of illuminating engineering. To this end he should give every possible encouragement and assistance to those who are honestly working to qualify themselves as practitioners. For an architect to turn down the whole proposition is to declare that there is no room for progress in this very important utility; and to seek or accept the advice of specialists in lighting, while refusing to recognize the profession by title, is merely a petty form of stultification. It is no more an admission of weakness on the architect's part to employ an illuminating engineer than it is to employ any other specialist in engineering; the profession has reached that point where there is no longer a valid reason for rejecting it as a false pretender.

Illuminating engineering is a fact, and the sooner the architect admits the fact and handles it with the same rigorous scrutiny that he does the other facts pertaining to his profession, the better it will be for himself, his clients and illuminating engineers.

Status of the Engineering Profession

Mr. William McClellan, in a letter to the *Engineering Record,* presents some opinions on this subject which are particularly worthy of the attention of those who are striving to establish the profession of illuminating engineering. The following paragraph is particularly pertinent:

"When we recognize that before a man becomes a specialist in engineering—elec-

trical, mechanical, civil, hydraulic, sanitary, illuminating, or what not—he must first become an 'engineer' in a broad general sense; when our colleges and technical schools train young men who desire to enter any branch of the engineering profession so that they may worthily deserve the degree of 'Bachelor of Engineering,' instead of one of the variety of degrees which they now get; when a greater number of our practicing engineers think more of the human and economic side of their work and become 'engineers' in reality instead of high-class mechanics, then a feeling of unity will come into the profession similar to that which exists in law, medicine and, to a smaller extent, among the clergy."

The word "engineer," as a title to a profession, is unfortunately falling into something of the same degradation through unlicensed and miscellaneous use that has befallen the title of "professor." By right, the latter title belongs only to one holding a degree from a regularly chartered and reputable institution of learning. Since there is no legal restriction in the matter, however, the title has not infrequently been assumed for purely commercial or social purposes, and as frequently bestowed where it was unjustified, as a mark of personal compliment. A "professor" to-day, so far as the title goes, may be anything from a corn doctor to a university president. The literal meaning of the word "engineer" is very broad, viz., any one skilled in the use of engines—an engine being an instrumentality, as well as a specific machine; and so we hear of "commercial engineers," "publicity engineers," and so on down the line. Instead of advertising for a "girl for general housework," we shall probably soon have to seek the services of a domestic engineer; and in place of the stenographer and office boy we shall have the correspondence engineer and the general deviltry engineer.

Engineering, in its broad, modern sense, is simply and specifically the application of science to practical affairs. There will naturally be as many divisions of engineering as there are divisions of science which are applicable to the practical and economic affairs of life. Before any particular branch of science can be applied there must be a general broad basis of knowledge covering the fundamental principles of all science. Chief among these is the division now included under the subject of physics. This deals in the broadest possible way with the subjects of matter and force, which are the very foundation of all natural phenomena. Next in order is the subject of chemistry, which is the basis of life. These subjects form the trunk of the tree of scientific knowledge, from which it branches and subdivides into a complex organism.

It is useless to expect to produce the fruit of results by simply clipping off a twig and sticking it into the ground. If illuminating engineers expect to justify their title in the eyes of other engineers and their own clients, they must start, as the others have done, with the fundamentals, and develop in an uninterrupted progression through the various branches of the subject of science. If illuminating engineering is not reducible to a scientific basis it is not engineering: it may be an art. It requires but a superficial study of the subject, however, to show positively that not only is illumination almost entirely a matter of science, but that it depends upon a greater number of the divisions of pure science than perhaps any other branch of engineering. Physics, chemistry, physiology, psychology, electricity, optics, all have an important place in its make-up.

Mr. McClellan makes an excellent suggestion, viz., that colleges, instead of giving the numerous specific engineering degrees as at present, should give the one general degree of bachelor of engineering, thereby indicating that the bearer of it had laid the broad, scientific foundation necessary to become an engineer. The specific branch of engineering, such as mechanical, electrical, etc., might then well be given as a higher degree. If this practice were generally adopted by colleges and universities we should at least have a check against the unwarranted assumption of the title of engineer in any of its divisions. Any one then assuming a particular title, such as illuminating engineer, would thereby indicate only the fact that he had specialized on the subject of illumination, such specialization being based upon a broad general knowledge of engineering. This would undoubtedly largely prevent the assumption of this, or any similar engineering title, by those who were disposed to make unwarranted use of it.

Lighting of the New York Subway Cars

The lighting of the New York Subway cars has been recently brought into public notice as the result of a publicity campaign carried on by the *Evening Mail.* Through this agitation the matter was brought before the Public Service Commission of this district for a hearing. The proceedings before this tribunal are of special interest to illuminating engineers, for the reason that the testimony, which in these hearings is in the form of "complaints," was to a considerable extent expert, and dealt with the subject on an illuminating engineering basis. Perhaps a still more interesting phase of the testimony was the astounding lack of the most elementary knowledge of the scientific principles of illumination on the part of the general manager of the company operating the Subway system and similar innocence on the part of the commissioners.

The cars are lighted with carbon filament incandescent lamps placed along the edge of the ventilating well in the center of the car, and in the roof, 22 lamps being used in all. When the Subway service was first started 16 c.p. lamps were used, but after the "new broom" period had passed these were replaced with 10 c.p. lamps. As these lamps are on the same circuit with the power there is naturally a large fluctuation in voltage, so that the lamps run off to a half or quarter of their rated candlepower when the current is first put on full load. Clear lamps without reflectors are used.

The contract of the operating company with the city, which owns the Subway, specifies that the lighting of the cars shall be such as to enable one to read newspaper print easily. The complainants testified that they were unable to do so. The general manager of the company testified that they considered the original 16 c.p. lamps gave too much light, and they therefore cut them down to 10. He was not questioned as to whether this was done as a result of a public complaint of excessive light. It was brought out, however, by the expert electrician of the Commission that the 10 c.p. lamps could be operated at $40,000 less cost a year than the 16s.

The illuminating engineers who testified among the complainants dwelt particularly upon the evils of using bare, clear lamps, and pointed out the great advantage that would result from the use of proper reflectors and partially frosted lamps. The general manager stated to the Commissioners that the company would equip experimental cars with all of the different methods suggested, and let them judge as to which was the best. As a result a train was made up of eight cars each equipped in a different manner as follows:

Ten candle-power lamps, unshaded, such as are in use now.
Ten candlepower, with conical shades.
Sixteen candle-power lamps, unshaded.
Sixteens, with conical shades.
Sixteens, with lower part of bulb frosted and upper part shaded.
Sixteens, with reflectors.
Tens, with voltage regulator to keep current steady.
Sixteens, with voltage regulator.

Illuminometer measurements were made on the different systems, as well as general observations of the effect upon the eyes and the ease with which print could be read. The conclusions arrived at by the experts were as follows:

That 16 candle-power lamps, with frosted ends and crystal shades, gave the best results—a light that made it possible for passengers to read conveniently and with comfort, as the operating contract between the Interborough Rapid Transit Company and the city requires.

That the 10 candle-power lamps, similarly frosted and shaded, were better than the bare lamps now in use, but not bright enough to read without eye strain.

That the unshaded, unground 16s gave better general illumination and made reading easier than the unshaded 10s, but that the results were not so good as with shades and partially frosted bulbs.

That the 16s with tinned reflectors gave an unpleasant glare.

That the 10 candle-power lamps as used since the Interboro substituted them for the 16s were entirely too dim for the comfort of the passengers.

Notwithstanding that this report is decidedly in favor of the use of partially frosted bulbs and reflectors, the Commission has waived this point and merely required the company to replace the 16 c.p. lamps as originally used. Those who attempt to read will find their papers somewhat better lighted, but the majority of passengers, and especially the strap-hangers—that large and long-suffering portion

of the community—will have a greater glare in their eyes than before. On the whole, it is doubtful if this order will be for the greatest good of the greatest number. There is no possible excuse for the Commission not requiring the installation of the system shown to be best by the experts in the case. The additional cost as compared with the cost of equipment and operating expense would be a mere bagatelle, and as the last report of the company showed that their total cost of carrying passengers is approximately 2 cents each, they have no particular claim on the court for mercy.

While illuminating engineers may congratulate themselves to the extent that the matter was referred to experts and investigated in accordance with well recognized principles of the science, they must feel a sense of disappointment and regret that the case was not decided on the merits of the evidence.

The Subway stations are still travesties on modern illumination, and the fact that the tungsten lamp would completely let the company out of the blunders which were made in the original installation, should be a sufficient cause to require the immediate overhauling of the lighting so as to bring it up to modern practice. It remains to be seen what the Commission will do in this regard.

The Fifth Annual Meeting of the National Commercial Gas Association

The fifth regular annual meeting of this association was held in the Concert Hall of the Madison Square Garden December 14 to 17. The attendance at this meeting, the interest displayed in the proceedings, and the increasing list of membership are all strong evidences of the vitality and importance of this association. Those who in the beginning prophesied that it was "doomed to failure" have not added to their reputation as prophets.

There were three papers presented on lighting subjects, viz.: "Street Lighting," by E. N. Wrightington; "The Future of Gas for Store Lighting," by R. R. Young; and "The Necessity of an Artistic Gas Fixture." by LaForrest F. Blyler. The review of these papers will be found in another department.

On Friday evening, December 17, a joint meeting of the New York Section of the Illuminating Engineering Society, and this association was held in the Concert Hall. The programme consisted of a stereopticon lecture by Mr. H. Thurston Owens on "Street Lighting Fixtures," and a paper by Messrs. Lansingh and Rowe on "Modern Gas Lighting in the Home, Office and Store," presented by Mr. Rowe.

The officers elected for the ensuing year are as follows:

President,—E. N. Wrightington, of Boston.

First Vice-President,—H. B. McLean, of New York.

Second Vice-President,—Carl H. Graf, of Indianapolis.

Third Vice-President,—A. V. Wainwright, of New York.

Secretary,—L. S. Bigelow, of New York.

Treasurer,—P. S. Young, of Newark, N. J.

The British Illuminating Engineering Society

The final step in the organization of the British Illuminating Engineering Society was taken on the evening of November 18, when the first president, Prof. Sylvanus P. Thompson, was formally inaugurated. That a man of Professor Thompson's ability and world-wide recognition has accepted the chief place in the society's official staff is a sufficient evidence that illuminating engineering is to assume a position as a distinct branch of science and a legitimate profession, not only in England and the British possessions, but throughout the continent of Europe. Professor Thompson is familiar to every American student of electricity through his admirable books on the subject. There are few scientists in the world to-day who can be classed with Professor Thompson in the ability to make scientific subjects not only plain but positively attractive and readable.

While America was the first to give the new science a "local habitation and a name," much work of a highly scientific, engineering character had been previously done in England. It would surprise many American illuminating engineers to find how much that has come up since the

foundation of our own society had been wholly or in part investigated and described previously in English publications. The subject of science in general has no particular place or country, but, like nature herself, of which it is a study, is world-wide. The human eye is the same in structure, and the basis of the illumination which will best serve its purpose the same in England as in America.

The two societies are working for a common purpose, and should therefore supplement each other's work to a large extent. The sympathy and union between the two societies in their common field can therefore not be too close.

Following the inaugural address appreciative speeches were made by Sir Boverton Redwood, A. P. Trotter, Dr. Walmsley and Mr. W. Mordey, past presidents of the Institution of Electrical Engineers, and by Dr. Haldane, F. R. S., one of the Gas Referees and a prominent physiologist of London. The character of these speakers shows the variety of support that is being given to the society.

The Illuminating Engineer extends its heartiest congratulations upon this most successful inaugural meeting.

Illuminating Engineering as Viewed by the British Technical Press

The formal launching of the British Illuminating Engineering Society, as noted above, has naturally brought out some interesting comments by the English technical press. Journals devoted to the gas, electricity and acetylene lighting industries in England are numerous, and generally of an exceptionally high class. Their editorial utterances on the subject may therefore be taken as representing the opinions of their constituents in regard to the movement looking toward the establishment of illuminating engineering as a distinct science and profession.

The *Journal of Gas Lighting*, now in its sixty-first year, may be considered the dean of technical journals dealing with illuminants. It is apparently not yet prepared to acknowledge that illumination is a branch of engineering, as its editorial on the inaugural meeting is headed "The Art of Illumination." While admitting the general usefulness of the Society along its professed lines, the *Journal* has some misgivings as to the effect of commercial rivalry between gas and electricity may ultimately have upon its proceedings. The editorial is particularly sound in its observations and advice. Among these are the following:

> The predominant claim for the society is that it will present to the art of illumination an impartial platform. So long as it does this, so long as it avoids questions of commercial contention, and devotes itself exclusively to matters of common concern—and there are many in which the whole of the illuminating agents are interested, together with physiologists, ophthalmic surgeons, architects, builders, road surveyors, and, in fact, the whole body politic—all will be well. The society has started well. That is agreed. It has before it a big expanse for useful exploration work. That too is agreed. It is the keen commercial rivalry that we fear will undermine the platform of impartiality. There is one thing the society must guard against, and that is any attempt to accomplish too much in a short space of time. Ambitions are great; but there must be care in their pursuit.

The Gas World, which has generally been favorably disposed toward the formation of the Society, reports the inaugural meeting without comment.

The Electrical Times says:

> Professor Thompson, as we understood his argument, appears to have convinced himself that the illuminating engineer, as a separate entity, can be fully justified. If that be his view we cannot quite appreciate it. True, there is a lot to be done in artistic shading and grouping, but we shall have young ladies from Liberty's competing for that sort of business if we carry it too far. But how can the illuminating engineer stop the increase of progressive myopia or short-sightedness? He can assist those who already demand a better light, but he can do no more for posterity than the dentist can do for their teeth.

Electricity thinks that the Society has a possible future.

> The latest—the Illuminating Engineering Society—appears able to meet all criticism and bids fair to justify its existence. There is a wide field for research and inquiry in the little known subject of scientific illumination, and the society has my hearty good wishes for a prosperous future.

Electrical Industries treats the whole subject facetiously, which seems to be its natural manner of speech. After intimating that those responsible for its for-

mation have an ulterior selfish motive, it goes on to say:

Further jocular references on one side, it must be confessed, that there is a vast deal of work in front of this new organization. We are ready to admit that lighting problems and the standardization of lighting units and terms (where chaos at present reigns supreme), are in urgent need of settlement and adjustment, and we are equally ready to congratulate Mr. Leon Gaster upon the undoubted success of his first meeting.

Notes and Comments

Cortelyou Favors Publicity for Lighting Companies

ROOSEVELT'S RIGHT-HAND MAN DEMANDS A SQUARE DEAL FOR PUBLIC SERVICE CORPORATIONS.

The address of President Cortelyou of the Consolidated Gas Company of New York before the National Commercial Gas Association convention is worthy of attention both on account of his own personal prominence and the magnitude of the interest which he represents. His utterances on the subject of publicity are certainly sane and fair and should be carefully pondered by both consumer and producer. The following quotations from his speech are reported by the *Tribune:*

"You put the people in a position to be just and fair when you are frank with them," he said.

"They know that men cannot be expected to engage in the lighting industry, any more than in any other, that capital is not attracted to business undertakings, unless a fair profit is assured," continued Mr. Cortelyou, "and unless initiative and inventive genius and business sagacity shall have ample room for their expression and for their reward.

"Great as America is among the commercial nations of the world, we shall yet stifle her growth and injure her producers and consumers alike if we put too severe restrictions upon these elements essential to her prosperity. Let there be the safeguards of regulation or supervision, or whatsoever may be the designation of that official oversight which honest men need not fear, and which, if intelligently and fearlessly exercised, can do justice to corporation and citizen alike.

"But let it be clearly understood that supervision does not mean management and that you cannot put unjust burdens or unjust limitations upon the corporation and in the same breath exact the best service and the lowest rates.

"Speaking broadly, I firmly believe that, in the first instance, the public is much more concerned in the character of the service it receives than in the precise rate it pays for such service, and I wish that in the proper regulation of our corporations this consideration might receive greater weight.

"What I am saying is certainly plain enough to admit of no misconception, but I will put it in another form to make misunderstanding impossible.

"What the public wants and must and will have are efficient service, fair and impartial treatment, and such degree of publicity of corporate business affairs as will leave no reasonable man in doubt that the relation between the corporation and the public is one consistent with the rights of both.

"I believe that immeasurably the greatest immediate benefit that can come to public utility corporations will be through taking the people into their confidence. When they have done this they have impregnable ground from which to defend themselves against unjust attack."

Philadelphians Still Anxious for More Light

EVERYBODY WANTS HIS STREET LIGHTED AS WELL AS THE NEXT.

Before the installation of the memorial lighting fixtures around the City Hall a year ago last fall, the only really bright thing in Philadelphia was the fronts of the moving picture theatres. Since its historic celebration, however, Philadelphians have been fairly agog over the question of better lighting. As previously noted in these columns, a fine new installation is now being put up in Market street, its widest business thoroughfare. The Walnut street merchants have privately lighted the business section of that thoroughfare for the past year, and various business men's associations have been formed for the purpose of securing light for their particular sections. All of this is well. Wherever business naturally centers there should be light in abundance. But while glorying in these more or less spectacular installations it is well not to forget the dark spots and outlying sections. On this point the *Record* has the following very sensible advice, which is of more than local application:

It is all right to light up Market street in such a way as to make that thoroughfare a perfect model of radiance. Who objects? Nobody. It is becoming more and more a grand crosstown midway, and deserves all the attention it can get in the matter of paving and lighting and everything else.

But in making Market street a shining path outrivaling the aurora borealis, is there not danger of neglecting other sections of the city? How about certain dark spots such as that at Wayne avenue under the Reading road? There are hundreds of these unlighted places in the built-up, as well as outlying, parts of the city. They are just the scenes for hold-ups and other outrages. Why not light these crime corners before proceeding to make Market street so brilliant as to hurt the eyes?

Fiat lux; but let the light shine in the dark places.

Another City to Be "The Best Lighted Town in the West"

POMONA, CAL., PLANS TO MAKE THIS CLAIM.

The following special to the San Jose *Herald* tells the story:

The local City Trustees and Business Men's Association are making plans for the lighting of principal streets in Pomona which, if consummated, will give the city the best system of street illumination in the West. It is proposed to erect lofty steel ornamental arches across the streets at regular intervals, upon which will be a series of electric lamps. If the property owners along the streets proposed for illumination will pay for the arches, the city will pay the cost of the lighting.

Public Lighting as a Monument to History

PHILADELPHIA PLANNING AN HISTORICAL LIGHTING INSTALLATION FOR INDEPENDENCE SQUARE.

Philadelphia was the first city of the Union to utilize the modern lamp post as an historical monument. This was done in a very fitting manner in the installation placed about the City Hall. That this has met with general public favor, both from the practical and sentimental viewpoints, is evidenced by the fact that plans are now being matured to place an even more elaborate system in Independence Square, in which is situated one of the most cherished of the relics of the foundation of our nation, viz., the so-called Independence Hall. The following interview reported by the *Press* gives interesting details:

Said Chief McLaughlin yesterday:
"Mayor Reyburn has suggested, and I am working on the details of some 56 memorial lamps to be placed in Independence Square. They are to be of artistic design and each is to have engraved on the specially designed globes the name of the respective signer in whose honor the lamp is erected.

"Furthermore, it is proposed in the restoration of Independence Hall to work out an illuminating system which, through electricity, will represent the history of illumination from the Revolutionary times down. The tallow dip, the oil lamp, the what-not, are all to be worked out in detail, but with the electrical current as the source of power."

New York, December 4, 1909.

To the Editor:

Dear Sir: It is with pleasure and even with a certain kind of satisfaction that I take the liberty of expressing my high appreciation as to your excellent editorial on "Engineering and Esthetics." In a very eloquent manner you uphold what I have advocated and pleaded for in my article on "Rudiments of Illuminating Engineering," published in your magazine April, 1908, and especially in my lecture on "Engineering Problems in Illumination" delivered at the second convention of the Illuminating Engineering Society.

But it is not only appreciation and satisfaction which induces me to write these lines, but rather it is in the interest of the illuminating engineering profession to remind of the fact that one must offer original and practical results in order to be recognized, and that an engineer is supposed to produce engineering feats. A year ago I was kind of discouraged by the attitude in certain quarters of our society, in fact, by the general spirit manifested on occasion of the second convention of the Illuminating Engineering Society, which went so far as to deplore my tendencies in illuminating engineering.

At the last meeting of the New York Section of the Illuminating Engineering Society and in connection therewith in your editorial mentioned above, I find that the recognition of real illuminating engineering is about to be sanctioned more efficiently, and I greet this movement as the beginning of a new era for the progressing illuminating engineer.

Very truly yours,
Alfred A. Wohlauer.

Commercial Engineering of Illumination

The Gas Show

The Gas Show now being held (Dec. 16-22) in the Madison Square Garden in this city, under the auspices of the National Commercial Gas Association, must be looked upon as the representative effort of the gas industry in this country to exhibit the popular uses of their product. It differs from the Electrical Shows that are annually held, here and in other cities, in being conducted by a national organization instead of by private enterprise. This ought to result in a just balance of representation between the various branches of the industry,—as it apparently does. In a word, the gas industry of this country is on public exhibition. Even a cursory glance over the exhibition room will impress the beholder with the fact that illuminating gas is still one of the great modern illuminants; and a more detailed study will show what revolutionary changes gas has made in domestic economy and in many manufacturing processes. The "show" is up to its opportunities and the demands made upon it. It is an impressive spectacle and an instructive exhibition.

The illumination is particularly noteworthy. The impression is very distinct on entering the hall that, while it is brilliantly illuminated, there is no undue strain upon the eyes; and particularly impressive is the daylight quality of the light. The fact brought out scientifically, and frequently alluded to in these pages, that the mantle gas lamp is the nearest approach to daylight in color quality of any of the regular commercial light-sources of to-day, is given an impressive ocular demonstration in this exhibition. The arrangement of the illumination is in excellent taste; a triple row of chandeliers supporting gas arcs being suspended from the roof, and the arches of the upper balcony outlined with mantle burners and opalescent globes. The result is attractive and pleasing without being strained or overdone.

It is not the place here to go into a detailed description of the many individual exhibits. It will suffice to say that the show is a decided success, and a fair representation of this great national industry.

There is one important manufacturing interest connected with the gas lighting industry, however, which is decidedly "conspicuous by its absence," and that is the fixture trade. The extent to which fixture manufacturers have given themselves over to electric lighting and have ceased to progress in the design of gas lighting fixtures was fully brought out in a paper read before the Association, which will be found abstracted elsewhere. Price will determine the purchase of an article to a certain extent with every one, and wholly with a certain class of purchasers; and so will quality. When a given commodity possesses both, as gas light unquestionably does, it is inconceivable that alert business men should neglect either. Better gas-fixtures are a crying need at the present time, and there is an opportunity for both profitable effort on the part of the manufacturers, and a means of extending trade on the part of the gas producers by seeking to supply this demand.

The Relation of Street Lighting to Night Traffic

BY JOHN M. CONNELLY.

Denver is known throughout the country as the "City of Lights." The justice of this term will not be questioned by any one who has compared the down-town streets of Denver with similar streets in cities of similar size. Most of the lights which turn night into day in the business streets of Denver are private lights, electric signs and window illuminations. The city government has done much, and has done it in artistic fashion, to light the streets; but in the business area the advertiser has quite outdone the "city hall."

It would seem, therefore, that Denver is a good city in which to study the influence of private lighting on the evening traffic in the streets. The Denver Gas & Electric Company, acting on the suggestion of its president, Mr. Henry L. Doherty, has made a fairly complete count of the persons passing seven selected points in the city. The figures, with some conclusions which seem justified by the same, are here presented:

METHOD OF COUNTING.

Men were chosen for the work of counting, and each provided with automatic registers, which will keep tally as fast as the thumb can be pressed on the indicator. The points selected were the intersections of certain streets. Eight men were employed to keep tally on the foot passengers; two on each side of the street, about 50 ft. back from the corner, each way. In this way each foot passenger was counted twice—with certain exceptions to be noted later—and in making up the final totals this duplication is allowed for. Other men had charge of counting the street cars; others counted the vehicles, including bicycles, horses and carriages and motor cars; others estimated the number of passengers in the street cars, and still others counted the number of passengers in the vehicles.

Everything was done to insure accuracy; and it was felt best that all departures from accuracy should be understatements rather than overstatements. Thus the men who counted street car passengers knew the capacity of each kind of street car passing. It was easy to count the full cars, easy to count the empty seats and make the deductions in cars that were nearly full, easy to count the passengers in cars that were nearly empty. It was impossible to make accurate count of the passengers in crowded cars, and therefore these were put down in the total simply at capacity. The hours of counting were from 5.30 to 9.30 p.m. This included both the evening rush homeward from business and the later and smaller crowding down to the theaters. At both these times Denver cars are commonly crowded to the steps, so there is no doubt that the total number of street car passengers was much larger than that given here.

The count of vehicle passengers is substantially exact. The count of foot is exact, with two exceptions. Curtis street is the theater street of the city. It has already been explained that the number of foot passengers is added together and divided by two to get the number here given. Owing to the way the street cars arrive in the theater region of Curtis street it is certain that the majority of the theatergoers would pass only one counter before going to their chosen place of amusement; yet here, as everywhere else, the count is divided by two. No other method, indeed, was practical. The visitors to the Orpheum Theater on Welton street were also figured as being counted twice, though almost none of them were really counted more than once.

The figures presented are therefore as accurate as it is possible to make them; and where absolute accuracy is impossible the figures err on the side of conservation.

DETAILS OF THE COUNT.

SIXTEENTH AND CURTIS STREETS.

Vehicles	2,866	
Street cars	460	
Street car passengers		23,450
Vehicle passengers		8,598
Foot passengers		43,421
Total passengers		75,469

FIFTEENTH AND ARAPAHOE STREETS.

Vehicles	1,834	
Street cars	697	
Street car passengers		34,850
Vehicle passengers		5,502
Foot passengers		14,015
Total passengers		54,367

The big tramway "loop" is just off Fifteenth and Arapahoe streets. This accounts for the disproportionate number of street car passengers as compared with foot passengers.

SIXTEENTH AND CALIFORNIA STREETS.

Vehicles	1,509	
Street cars	373	
Street car passengers		18,650
Vehicle passengers		4,527
Foot passengers		9,468
Total passengers		32,645

SEVENTEENTH AND LARIMER STREETS.

Vehicles	1,864	
Street cars	289	
Street car passengers		7,225
Vehicle passengers		5,592
Foot passengers		12,580
Total passengers		25,397

Larimer street is one of the old streets of the town, once containing the best business houses, now largely given over to second-hand stores and pawnshops, but gradually coming to its own again.

FIFTEENTH AND WELTON STREETS.

Vehicles	620	
Street cars	597	
Street car passengers		29,850
Vehicle passengers		1,860
Foot passengers		8,036
Total passengers		39,746

Fifteenth street is the street car street, the one favored by the tramway company. The discrepancy between the number of cars on this and Sixteenth and Seventeenth streets will be noticed at once.

SEVENTEENTH AND STOUT STREETS.

Vehicles	912	
Street cars	256	
Street car passengers		12,470
Vehicle passengers		2,689
Foot passengers		10,177
Total passengers		25,336

BROADWAY AND COLFAX.

Vehicles	2,757	
Street cars	597	
Street car passengers		31,450
Vehicle passengers		7,271
Foot passengers		4,576
Total passengers		43,297

The crossing here listed is on the edge of the business district proper, but on the line that all the chief street car lines pass in coming from the largest residence district downtown. It is probably the only place in Denver where the number of vehicle passengers is greater than the number of pedestrians.

PASSENGERS AND LIGHTS.

Just as they stand, the above figures are of immense value to all Denver merchants and to all prospective investors in real estate. The worth of a business location primarily depends upon the number of people who pass it during business hours. The value of each passerby to the real estate depends largely on the nature of the view he gets of the business houses passed. Thus a thousand pedestrians are obviously more valuable to a storekeeper in any given locality than a thousand persons passing on street cars. The problem of the merchant is thus first to learn the main channel of pedestrian travel, and, second, to draw the greatest possible amount of the current his way.

Here is where some further investigations are of value. The company not only counted the passers by each location, but counted the lights and figured up the candle power for a block each way from the places of counting.

The result, reduced to figures, are rather startling. They show that lights—that is, window illumination and electric signs—have much more to do with determining the evening flow of pedestrian traffic than the street cars have. From the data secured it is believed that one can almost predict the number of foot passengers who will pass any given corner by the number of candle power in the lights of that block. Men and moths do not seem to differ so widely in their habits as one might think. Given a bright light in a neighborhood, and free will, both of men and moths, become purely an aca-

demic question. Both make for the light.

At the various points where observations were made the number of foot passengers at each of six counting stations and the candle power of the lights for one block each way from the corner showed distinct relations. It was generally found that the number of foot passengers varied between 0.78 and 1.27 per candle power in the blocks centering at the corner where the count was taken. For instance, the candle power at Sixteenth and Curtis streets is 44,662 and the pedestrians 43,421. With more frequent counting, the limits of variations would doubtless be reduced.

At one place, Seventeenth and Stout streets, the lights seem to have unusual powers of attraction, more than three foot passengers per candle power. On one corner is one of the busiest hotels, with lavish lighting outside and inside. One of the striking characteristics of the corner is that the foot passenger traffic on the sidewalks running by the hotel on Seventeenth street is twice as great as across the street, where there is no private lighting.

It is to be noted also that at the most frequented intersection the lights are the attractive force—not any sort of business. All the theaters on Curtis street will not hold more than a quarter of the number of the pedestrians who passed the intersection of that street with Sixteenth. Besides, 26,441 persons walked along Sixteenth street, where there is only one theater, against 16,950, who traversed Curtis street in the same time. It has already been shown that the theatergoer in this count usually passed but one checker, though given credit for passing two of them, so that the presence of the theaters tends to lower the apparent number of passers. The crowds come for the lights.

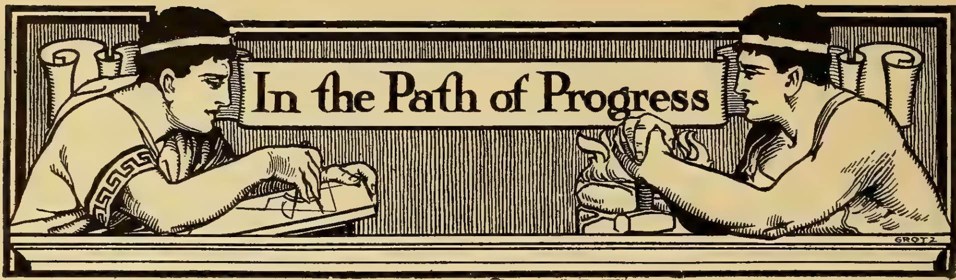
SUMMARY.

The count thus taken by the Denver Gas & Electric Company is the first known effort to give definite information to the merchant of the number of people he can expect to reach by his sign. It likewise tells him much of the drawing power of lights, and it tells him what sort of light signs he must use to get results at a given corner. Obviously, the sign meant to attract the attention of the street car passengers must differ widely from the sign addressed to pedestrians. The merchant who aims primarily to fix his locations in the minds of the people by means of a distinctive electric sign that will compel association with his locality, can easily make his sign of triple force in reaching equally well foot passengers, street car passengers and vehicle passengers. At any rate, the question of the kind of sign is up to the advertiser, but, of course, the central station is always ready to give him the benefit of its experience and observation. This count gives him a true line on the different kinds of travel and its measure, and the company is in a position to give its electrical advertisers the same definite information a newspaper furnishes its advertising patrons.

PUBLIC CONSIDERATIONS.

The merchant who puts out an electric sign does so in the hope of getting paid for it in trade. His motive is purely selfish. But, like all selfishness which is not blind, electric advertising works for the public good as well as for private good. Men, like moths, turn to the light, but there is one exception to be noted. Men who have evil designs on their fellows keep as much in the dark as they can. Light is not only an attractive force; it is a selective force. For centuries theologians have made vain endeavors to part the sheep from the goats. The modern merchant puts up a brilliant electric sign; and separates sheep and goats at once. The sheep come; the goats stay away. And such goats as do come are constrained to leave their butting propensities behind.

Light is the best known policeman. This has been proved by the experience of a thousand cities. But only in recent days has the private sign taken a hand in keeping the public peace.



A New and Clever Electric Sign

It is pretty well agreed among illuminating engineers and merchants that the lighting of a show window is on the same principle as the lighting of a stage setting, *i. e.*, the light-sources themselves should be hidden, and their rays concentrated upon the goods displayed so as to produce the effect of a brilliant picture. This is easily accomplished by the use of a reflector of some opaque substance placed along the top of the window near the front. Such reflectors ordinarily reflect about 75 per cent. of the light, the rest being absorbed and lost, so far as any useful purpose is concerned.

A very clever scheme of utilizing some of this loss of light to produce a transparent sign has been recently devised and offered to the trade by the Federal Electric Company, Chicago. The device consists of a reflector of the proper shape for throwing the light downward and backward into the window, but having its longer side plain. The reflector is made of opal glass, stained to an opaque color on the outside, with the exception of the plain

FIG. I.—WINDOW LIGHTED BY "ADLITES."

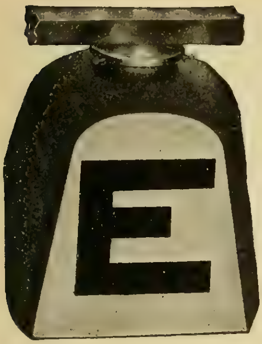


FIG. 2.—"ADLITE" UNIT

face, upon which a single letter is stained in any desired tint. By placing a series of such reflectors side by side any word or sentence may be formed. An example of such a combination sign and window lighting in use is shown in Fig. 1. The trade name "Adlite" is given to this sign by the manufacturers.

A Gas Solicitor's Handbook

The Welsbach Company deserves credit for being the first of the manufacturers of gas lighting apparatus to establish a *bona fide* department of illuminating engineering. This department has now been in operation for nearly a year, with results that are both creditable to the company and valuable to the illuminating engineering profession. A great deal of data on gas illumination, which heretofore had been entirely wanting, has been worked out and supplied. While the work has been done for the specific purpose of promoting the interests of the company, it is largely of such a nature as to be equally valuable to all who have occasion to use gas for illumination.

The results of this work have been summarized in a neat little booklet, under the above title, compiled by Mr. Norman Macbeth, who is in charge of the department. The advice given to salesmen is straightforward and in accordance with the best business ethics. It is simply an exposition of the good points of gas as an illuminant, backed up by facts and figures. Comparisons of cost between gas and other illuminants are given, both in the form of charts and tables.

On illuminating engineering Mr. Macbeth makes the following characteristically terse statements:

When as a gas company solicitor you advise the use of the right lamp in the right place, you are practicing illuminating engineering—doing all that the engineer would do. You should know something about the principles of illuminating engineering and the difference between good and bad lighting. Do not exaggerate the advantages of gas illumination—you don't have to. Don't waste your time in the attempt to prove that gas illumination is cheaper than other methods; your prospect knows that now, but may not know the advantage and quality at his disposal through modern equipment.

There is not a single artificial light source or system of illumination to-day which is 100 per cent. criticism proof, when the returns are all in.

Altogether this little booklet is one of the most valuable contributions to the subject of illuminating engineering that has yet appeared, and any illuminating engineer who fails to secure a copy is neglecting a valuable opportunity.

Announcements

The H. W. Johns-Manville Company has recently appointed Mr. H. H. Seaman, assistant manager of its New York electrical department. For seven years Mr. Seaman was associated with the Electric Storage Battery Company at Philadelphia, Detroit and Cleveland, and for the past two years has been manager of their Atlanta office.

The Parker-Clark Electric Company announces the retirement of Mr. W. G. Clark from his connection with the company and the election of Dr. George N. Miller to the office of president and director. Prof. H. C. Parker continues at the head of the laboratory work, and with the advent of Dr. Miller as the chief executive, active preparations are being made to at once place the company's products on the market.

The next convention of the Wisconsin Electrical Association (which is an amalgamation of the old Northwestern Electrical Association and the Wisconsin Electric and Interurban Railway Association) will be held at the Pfister Hotel in Milwaukee, January 19 and 20.

Proceedings of Technical Societies

The Fifth Annual Meeting of the National Commercial Gas Association, New York, Dec. 14-16, 1909

Street Lighting; by E. N. Wrightington.

Mr. Wrightington deals in his usual brief and pointed manner with the recent investigations of street lighting systems in Boston, the progress of which has been noted from time to time in our columns. The paper is too condensed to bear abstracting. It may be noted that the two mantle, inverted gas lamp was selected as the most feasible source for competing with electricity in street lighting. With gas at 80 cents it was estimated that these lamps could be operated at about $35 per year.

Mr. Wrightington states that, while lamps of this type were very satisfactory competitors of the enclosed arcs, they were not equal to the competition of the newer magnitite and flaming arcs, but that it is unreasonable to compare the latest forms of development in arc lighting with anything but the latest form of gas lighting, which is the high pressure lamp, which has found abundant use abroad but has not yet been commercially introduced into this country. The results of tests made both on the streets and in the laboratory of different lighting systems are given.

The Future of Gas for Store Lighting; By R. R. Young.

Mr. Young takes a cheerful view of the subject in his introductory statement:

"The possibilities of store lighting with gas have never been so bright as at the present time, in spite of the introduction of the tungsten lamp, with its widely advertised advantages of three times the light, for the same cost, and other attractive features, and there is no reason why gas illumination cannot keep in the lead if we look after the business in the right way."

Mr. Young is in favor of maintenance of gas lighting by the companies. "We cannot expect," he says, "the merchant to know as much about the lighting business as we do, and we ought to follow up any lighting appliance that is installed by us whether it is on a rental or sale lamp."

After discussing the subject from the commercial standpoint, in which the value of illuminating engineering is fully recognized, the writer has the following to say in regard to the subject of illumination itself:

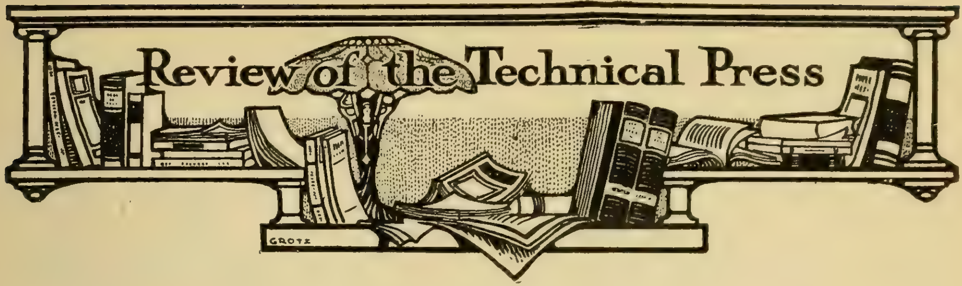
"The correct way theoretically to light a store is to have the regular inverted incandescent gas lamp fitted with the proper diffusing shade placed in single units over the counter, spaced and hung so as to have the light evenly distributed, but experience has taught us that, with stores of the usual width of 18 to 20 feet, the larger units of the inverted type of fixtures, such as the reflexolier fitted with proper shades, and the inverted arc lamp, are far more satisfactory to the customer. In the case of the larger units we reduce the number of parts to be taken care of, such as glassware, where there is one globe with the arc as against eight or ten pieces of glassware to the single lamps, and one pull instead of four or five when lighting, and only one pilot light to look after, the installation is more convenient to light and extinguish, and at the same time meets one of the arguments advanced by the electric solicitor for his wares—that of convenience."

The Necessity for an Artistic Gas Fixture; by LaForest F. Blyler.

The paper is short, but decidedly to the point.

The following advice is certainly good:

"The study of fixture design should go hand in hand with illuminating engineering, as the new high efficiency lamps and burners have a great influence with the newer designs. We should go back to first principles and take up architectural designing as an elementary study. As the wealth of this country increases there will be greater and more elaborate varieties of architecture, thus making an increased demand for knowledge along these lines."



American Items

NEW BOOKS.

The Decorative Periods. By Chandler R. Clifford. 300 pp. Cloth. $3.00, net. Clifford & Lawton, New York.

While the illuminating engineer is not the arbiter of art in the design of installations or fixtures, some knowledge of the various "periods" of decorative design is at least a very helpful collateral branch of information, if not of positive useful application.

Mr. Clifford's book is especially adapted to give just such information as will be most helpful. A special feature of the work is the large number of illustrations. The description is clear, taking the matter up in historical order, beginning with the most ancient nations. It is a work which every one who has any artistic tendencies should possess.

The Flicker Photometer, by Sydney W. Ashe; *Electrical World*, November 25.

Referring to the subject of color photometry, which the author states has received much consideration of late, he makes the statement that "it would seem from a general study of the research work on the subject of color photometry, and from the conclusions of many authorities in reference to this subject, that the only available method is one employing the flicker photometer." He then gives a general discussion of the subject of the various methods suggested for comparing the intensities of light of different colors. It will be interesting to note that his opinion of the flicker photometer is not shared by the photometrists of the Reichsanstalt in Berlin, which is undoubtedly the most generally accepted authority on these matters in the world. They recently gave out the statement that the flicker photometer has no advantages over the Lummer-Brodhun photometer for such purposes.

The Illumination of the New Building of the Denver Gas & Electric Co., by G. E. Williamson; *Electrical World*, December 9.

A detailed description of the lighting of the building, both exterior and interior, which has been laid out with an idea of eclipsing that of any other building in the country.

The Railway Electrical Engineer for December contains the following articles on illumination:

Illumination of the New Baggage Cars on the Chicago, Milwaukee & St. Paul Railway.

The article describes the very complete tests made on various systems of lighting for these new cars.

Railway Car Illumination, by C. R. Gilman.

States the elements of illuminating engineering in general from the different authorities, and shows how they can be applied to the particular case in hand.

The Illumination of Erecting Floors.

A description of the lighting installation of a large erecting shop in which mercury vapor arcs are used.

Tungsten and Tantalum Train Lighting Lamps, by C. W. Bender.

Describes in brief the various processes of making tungsten and tantalum lamps, and gives data of commercial lamps of this class suitable for train lighting.

Indirect Illumination.

A description of the lighting of the South Shore Country Club, Chicago.

Street Lighting in Newark, N. J., by H. Thurston Owens; *Electrical Review and Western Electrician,* November 20.

A description of the installation of flaming arc lamps recently put up in that city.

Lighting Fixtures for Arc Lamps, by Gilbert Mullock; *Electrical Review and Western Electrician,* November 27.

Gives some interesting illustrations of old and new lamp posts used for arc lighting.

The New Downtown Street Lighting System of St. Louis, by John E. Tiedeman; *Electrical Review and Western Electrician,* December 11.

Illustrates and describes the new downtown installation, of which much has been heard during the past six months.

Bedroom Lighting, by George Clifton; *Electrocraft,* December.

Calls attention to the necessity for the proper placing of switches, as well as light sources.

The Wiring and Correct Illumination of an Ordinary Eight Room House; *Electrocraft,* December.

Gives complete specifications for the lighting and wiring of a typical house of this size. It should be of much practical assistance to electrical contractors.

The Theory of Light and Color, by A. J. Marshall and F. Laurent Godinez; *Light,* December.

This is chapter 9 of the serial articles on "Light and Illumination," which were begun by Mr. Marshall. Describes the different methods of determining the velocity of light and the theory of the grease-spot photometer.

Tungsten Illumination, by Arthur J. Sweet; *The Electric Journal,* December.

This article, while comparatively brief, contains an unusual amount of valuable data and information, as well as the peculiarly plain directions and description which characterizes Mr. Sweet's writing. The particular aim has been to give such formulae and tables as will enable the non-technical user to make a satisfactory and wise use of this new lamp. On this point the writer says:

"The essential facts which it is here sought to emphasize are these: That the lamp user, though most often he knows it not, is face to face with the necessity of carefully applying the principles of illuminating engineering to his lighting system, in order to obtain economy of operation and minimum eyestrain; that a careful study and analysis of the many separate illumination problems discloses certain factors and relations common to all these problems; that by designing a line of light units with reference to these common relations, the principles of illuminating engineering may be correctly applied by the lamp user to his particular problem by the simple procedure of determining from a table the correct light unit and the proper mounting height corresponding to the particular conditions of his problem; and that the illumination results will be nearly or quite as satisfactory as could be obtained by the direct, personal services of the best illuminating engineer."

Special Street Illumination; *Municipal Journal and Engineer,* December.

An illustrated article describing the recent installations of spectacular street lighting in St. Louis, Mo.; Columbia, S. C.; Columbus, Ohio, and Norfolk, Va.

Indirect Lighting, by Bassett Jones, Jr.; *American Architect,* December.

Mr. Jones prefaces his discussion by dwelling upon the adaptibility and flexibility of the electric light. Commenting on this subject he says:

"Electric lighting, at its best, is expressive of the freedom that scientific achievement has secured for this age, and until our architecture also learns to embody this ideal of freedom, architectural design and modern artificial illumination must always clash to a greater or less extent.

"Perhaps the principal feature that electric lighting has introduced into the field of illumination is the possibility of doing away with the use of lighting fixtures."

Coming to the discussion of the main subject, indirect lighting, Mr. Jones declares that "no other method of illumination contains more pitfalls to attract the unwary." He then deals with the problem in the careful analytical manner which characterizes his work. It is probably the most valuable single article that has appeared on this subject.

Foreign Items

Compiled by J. S. Dow.

ILLUMINATION AND PHOTOMETRY.

Editorials: The Art of Illumination (*J. G. L.*, Nov. 23); Illumination Problems (*Electrician*, Nov. 26); Illumination (*Electrical Engineer*, Nov. 26)., etc., etc.

The most interesting event of the past month has been the inaugural meeting of the Illuminating Engineering Society in London on November 18, which is commented upon in a wide circle of papers, all of which express good wishes for the future of the society. The above three editorials are a few among many comments on the matter.

Inaugural Address at the Above Meeting of the Illuminating Engineering Society, by Prof. S. P. Thompson.

It is impossible within the space available to give an adequate idea of the address of Professor Thompson, the first president. It was most enthusiastically received and covered a wide range of subjects. The address is abstracted in a number of British journals.

The Physiological Theory of the Flicker Photometer, by J. S. Dow (Paper read before the Physical Society, London, Nov. 12).

The author describes some further experiments comparing the flicker photometer with instruments of an "Equality of Brightness" pattern, for the comparison of hetero-chromatic sources of light; an abstract of the paper is given in the *Electrician* (Nov. 26).

The Relations Between the Units of Illumination in Different Countries, by B. Monasch (*Illum. Eng.*, London, November).

The author publishes a revised table connecting the values of the units of illumination in use in different countries, bearing in mind the effect of the international agreement on the common unit of light between Great Britain, France and the United States.

Light in Custom and Superstition, by Dr. M. Gaster (*Illum. Eng.*, London, November).

The author shows how the worship of the heavenly bodies has led to the association of light with the conception of immortality and how various customs in different parts of the world involving this connection, such as the lighting of candles by the bier, etc., have developed.

Spectrophotometres et Photométrie des Sources Colorées, by J. Thovert (*Jour. de Physique*, November).

Discusses color photometry and describes a simple form of spectrophotometer for use on an ordinary photometric bench.

Illumination, Its Distribution and Measurement, by A. P. Trotter. (Continued.) (*Illum. Eng.*, London, November).

Die feuerfesten Stoffe und die Heizungs und Beleuchtungstechnik, by O. Vogel (*Z. f. B.*, Oct. 30).

Discusses the application of refractory oxides and other materials to illuminating and heating purposes.

A Fourteenth Century Standard for Wax Candles (*Illum. Eng.*, London, November).

Contains some particulars of a specification for the manufacture of candles by the Guild of Wax Chandlers in London in the fourteenth century; an analogy is drawn between this interesting document and the need for a specification for illuminating apparatus at the present day.

Light Conversations in Illuminating Engineering (1) Glare (*Illum. Eng.*, London, November).

Fortschritte im Beleuchtings und Luftungstechnik (*Z. f. B.*, Oct. 30., Nov. 10, Nov. 20).

ELECTRIC LIGHTING.

THE PRESENT ASPECTS OF ELECTRIC LIGHTING, by Handcock and Dykes. (Paper read before the Institution of Electrical Engineers, Nov. 25.)

The paper discusses the effect on the revenue of central stations of the continued extension of the use of metallic filament lamps. The authors advocate a system of charging consumers a "lump sum" per quarter, based on their estimated contract demand and irrespective of the amount of electricity they may use.

ELECTRIC LIGHTING OF TRAINS, by A. Robb. (*Elec. Engineer,* Nov. 5.)

THE PROSPECTS OF ELECTRICITY IN DOMESTIC SERVICE, by W. H. Y. Webber (*G. W.,* Nov. 13).

ÜBER ELEKTRISCHE STRASSENBELEUCHTUNG (*J. f. G.,* Nov. 6).

ESPARNIS AN BETRIEBSKOSTEN DURCH INTENSIV-FLAMMENBOGENLAMPEN (*Z. f. B.,* Nov. 30).

A VILLAGE LIGHTING SCHEME (*Elec. Rev.,* Nov. 19).

ELECTRIC LIGHTING IN SMALL TOWNS AND VILLAGES (*Electrician,* Nov. 12).

THE WELSBACH METALLIC LAMP LEGAL ACTION (*Elec. Engineering,* Oct. 23; Nov. 4; Nov. 11).

GAS v. ELECTRICITY (*Elec. Rev.,* Nov. 26).

GAS, OIL, ACETYLENE LIGHTING.

ASPECTS OF RECENT COMPETITION, by W. J. R. Baker (*G. W.,* Oct. 23).

NOTES ON GAS LIGHTING, by H. N. Clark (*G. W.,* Nov. 6).

The author summarizes recent developments in gas lighting, making special reference to the use of high pressure gas for shop lighting, and comments upon the practically undeveloped field for gas of sign lighting. He and some of the speakers in the discussion following the paper also refer to the tendency of companies to assist consumers by the sale of mantles and by providing free attendance to maintenance and renewals.

THE CHEMISTRY OF FLAME, by H. B. Dixon (*J. G. L.,* Nov. 9; *G. W.,* Nov. 13).

ADVANCES IN INVERTED GAS LIGHTING, by M. Scholz (*J. G. L.,* Oct. 26).

The author summarizes progress in gas lighting in Germany, especially in inverted high pressure lights such as are used in Berlin; he states that the mantles used with these lamps are renewed every 200 hours.

ADDRESS TO THE LONDON, SOUTHERN JUNIOR GAS ASSOCIATION, by C. Woodall (*G. W.,* Oct. 30).

ELEKTRISCHE GASFERNZÜNDER, by Wendt (*E. T. Z.,* Nov. 4).

APPARAT ZUM SELBSTTÄTIGEN ZÜNDEN UND LÖSCHEN VON GASLAMPEN (*J. F. G.,* Nov. 20).

GASZÜNDVORRICHTUNGEN ELEKTRISCHE ZÜNDER (*Z. f. B.,* Oct. 30; Nov. 10).

CHEMISCH WIRKEND ZÜNDER (*Z. f. B.,* Nov. 20).

The above three articles deal with methods of automatic ignition and extinguishing of gas lamps. The articles in the *Zeitschrift für Beleuchtungswesen,* which are the continuation of a series dealing with all the various methods of ignition, are exceptionally complete.

STARKLICHTLAMPE OHNE PRESSGAS (*J. f. G.,* Nov. 6).

A new form of high candle power incandescent gas lamp, the "Lucas-Bamag," which is said to yield over 1000 candlepower, but does not require high pressure gas to secure this result.

THE LIGHTING OF THE ALEXANDRA PALACE, LONDON.

Describes a gas installation at the above place of entertainment recently converted from low to high pressure gas. The large central hall is lighted by a large number of high pressure lamps placed high up.

ILLUMINATED SIGNS (*G. W.,* Oct. 30).

VERSUCHSANSTALT FÜR GASBELEUCHTUNG IN WIEN (*J. f. G.,* Oct. 30).

ANTIFAX ANGEBLICH EIN MITTEL ZUR ERHÖHUNG DER HALTBARKEIT VON GLÜHKÖRPER (*J. f. G.,* Nov. 13).

L'INDUSTRIE DE L'ACÉTYLÈNE EN AMERIQUE (*Rev. des Eclairages,* Oct. 30).

ART, COLORS, AND ACETYLENE (*Acetylene,* November).

The
Illuminating Engineer

Vol. IV FEBRUARY, 1910 No. 12

GOOD LIGHT IS EVERY MAN'S RIGHT

The founders of this nation laid down the fundamental axiom of civilization that every individual is endowed with certain inalienable rights, among which are life, liberty and the pursuit of happiness. These rights constitute man's natural inheritance. To deprive him of any of them is to deprive him of his birth-right.

Life, liberty and the pursuit of happiness require the use of artificial light. Whether at work in the factory, store, or counting room; whether walking in the streets of the city, or riding in public conveyances; whether reading at home, or in the public library; whether worshipping in church, or enjoying the theatre; whether in the tenement house or the mansion; whether young or old, every civilized human being has a right to demand and receive good artificial illumination.

Science, among its other inestimable boons to humanity, has furnished the means whereby every civilized human being may have not only good, but the best possible light for his particular purpose. Not only are the means of producing it obtainable, but the cost is such as to bring it within the reach of every one having sufficient earning power to sustain life; and those who are not thus endowed have as good a right to demand light as food.

Every man who employs labor is in duty bound to protect the lives of his laborers, not only to the extent that they may merely exist, but that they may pursue their callings with the greatest possible comfort. The employer who compels his employees to work under poor illumination is a robber; he is robbing them of a portion of their birth-right. Public officials who do not sufficiently light up the streets and byways of the city are recreant to their duties. Those responsible for the management of schools and libraries who permit readers and pupils to strain their eyes and nerves with poor illumination are a menace to human welfare, and unfit to have jurisdiction over others. People who deliberately deny themselves the benefits of good lighting in their homes fail of man's highest duty—to give himself the most complete facilities obtainable for his own development and pleasure.

Bad lighting, anywhere and everywhere, is an inexcusable, unpardonable sin.

Let there be MORE *light!*

E. L. Elliott.

Factory Lighting

Design of Illumination of a Weaving Room

By L. B. Marks

In my paper on "Factory Lighting," read at the convention of the Illuminating Engineering Society last September, the results of an extended investigation of the lighting of four large typewriter factories and one ribbon factory were presented. The lighting of the factories referred to is typical of that of the majority of factory buildings and is carried out by what is known as the localized system of illumination. With this system of lighting each operator at machine or bench is provided with an individual lamp placed more or less close to the work.

The present article treats of the lighting of the Shelton Mills, Shelton, Conn., of which Messrs. Sidney Blumenthal & Co. are the proprietors. In Mill No. 1 (old mill), silk velvets, velours, etc., are manufactured, and in Mill No. 2 (new mill), dress goods, mohairs, worsteds, etc.

The proprietors had planned to install in the new mill a lighting equipment precisely similar to that in the old. A demonstration was made to convince them that they could obtain vastly better results if the lighting of this particular class of work were accomplished by general illumination combined with directed lighting rather than by strictly localized lighting such as was used in the old mill.

Though the amount of current required for the proposed new system of lighting was much larger than used in the old, the demonstration convinced the proprietor that it would be poor economy to duplicate the old and cheaper system originally contemplated.

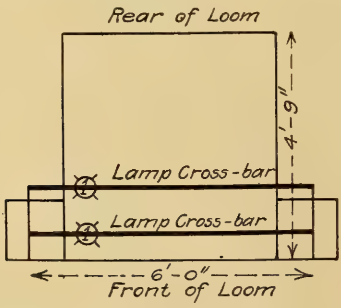


FIG. 1.—PLAN OF LIGHTING LOOMS, OLD MILL, LAMPS MOVABLE.

LIGHTING EQUIPMENT OF OLD MILL.

In the weave room of the old mill each loom is equipped with two 110 volt 16 candlepower carbon lamps backed in most cases by 5 in. by 10 in. tin reflectors, enameled white on the inside. (See plan, Fig. 1, and illustration, Fig. 2.) One of these lamps lights the front and the other the rear of the loom. Each lamp is hung from a cross bar specially provided on the loom, to permit of lateral shifting of the lamp along the entire length of the loom. The distance from the lamp to the working surface of the machine is usually from 1 ft. to 1 ft. 6 in. With this system of lighting, only that portion of the work immediately beneath the drop lamp is brightly lighted. If the lamp is at one end of the loom the other end is in darkness. The operator shifts the lamp as he proceeds with the work, to meet his requirements of illumination.

The general conditions of lighting in the old mill, which are typical of many lighting installations of this class, may be gathered from the following extract of a report on the lighting of this mill, made about two and a half years ago, as follows:

The general conditions of the lamps, reflectors and globes is very poor, many of the lamps being far below normal candle power, and the reflectors bent, badly tarnished, and thickly covered with dust. The wiring for drop lamps, which are used throughout, is in poor condition, being knotted in some cases and frayed in others. The principle upon which the mill is lighted is that of strictly localized illumination in contradistinction to general illumination.

Some of the reflectors in the weaving department are shallow, thus exposing the eyes of the operators to the unshaded lamp. The light from an unshaded clear

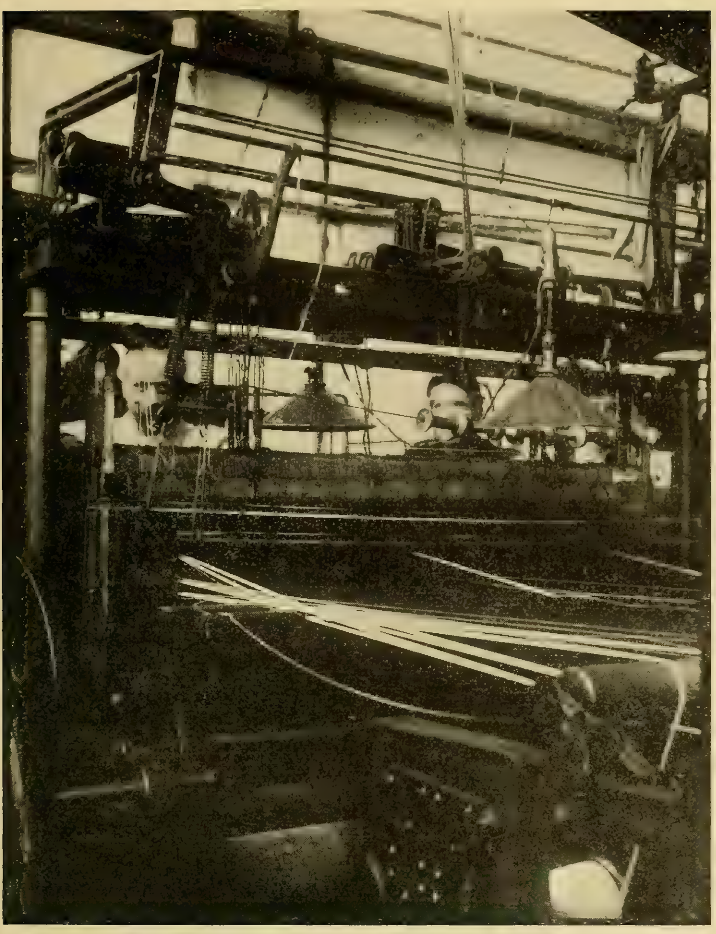


FIG. 2.—METHOD OF LIGHTING LOOMS, OLD MILL, LAMPS MOVABLE.

glass lamp, though not necessarily large in candlepower, is extremely trying to the eye, even though the lamp be only an 8-candlepower lamp. Exposure of the eyes to these lamps reduces the sensibility of vision.

Owing to the manner in which the operators handle the lighting units in the course of their work, I find that the advantages of shielding the light from the eyes by the deeper reflectors in use in this mill are to a large extent lost, because the operators at the adjacent machines are subjected from time to time to the glare of light from the neighboring lamps. The lamps are hung very low and close to the machines, with the result that there is a strong glare from the work, and it is necessary, as the work progresses, to push the lamp to either one end of the loom or the other and to readjust the angular position of the lamp in order to properly illuminate that portion of the work on which the operator is engaged. Similarly, it is necessary for the operator to occasionally examine the work at the rear of the loom, in which case he manipulates another lamp hung from a bar in the rear on which the lamp may be slid along. In short, the operator appears to be concerned to a far greater extent than is necessary with the manipulation of the lamps in order to direct the light where he wants it as the work progresses.

The lighting of this room is what is technically called "spotted" lighting. In

looking along the room one sees a series of bright places or spots in a field of comparative darkness. Even though the surface illuminated by the spotted lighting be very bright, the eye is not capable of seeing as well for a prolonged period with lighting of this character as it is with lighting that is not so intense but more evenly distributed. Thus, for example, an operator working steadily for an hour with a light such as is now used in the mill, will not be able at the end of an hour to see the details (fine threads, etc.) of the goods as well as he could if he were working steadily with a light that was not nearly as intense but was spread evenly over the whole of his work.

The intrinsic brightness or, more accurately, the specific brightness of the filaments of the present lamps is somewhat over 500 candlepower per square inch of lighting surface. If the eye is exposed to the direct rays of the lamp, the specific brightness of the lighting surface should preferably be as low as $\frac{1}{2}$ candlepower per square inch, or less than 1-1000 of that which obtains in this mill.

DESIGN OF ILLUMINATION OF NEW MILL.

In the design of the lighting of the new mill the object sought was, of course, to secure the proper amount and quality of artificial illumination at the minimum expense. Economy of lighting was a very important consideration, but even though the power required for the new lighting system was considerably greater than that required for the old, the proprietors were convinced that the additional cost of the new lighting system would result in *ultimate economy*, as it was believed that this extra cost would be far more than compensated by the increase in output and the improvement in the quality of the work made possible by the new lighting design.

In carrying out the lighting design consideration was given to the character of the work done; degree and quality of illumination required; economy of lighting; type of lamp to be used; location of lamps with reference to amount and diffusion of general lighting, directed lighting, field of direct vision, avoidance or reduction of glare, ready accessibility, exposure of eyes to heat of lamp; type of shade and reflector with reference to screening lamp from direct view, distribution of flux of light, best utilization of ceiling and wall reflection, intrinsic brightness, dust shedding, mechanical strength; method of suspension of lighting units to minimize vibration; switch control.

LIGHTING EQUIPMENT OF NEW MILL.

For the lighting of each pair of looms in the new mill three 187-watt frosted tip G. E. M. lamps were originally used. Each lamp is mounted in an enameled prismatic glass deep bowl diffusing shade 10$\frac{3}{8}$ inches wide at the bottom and 9 inches deep. One lamp is located centrally above the front of each loom and one lamp is located centrally above the space between the rear of two looms, as shown in the plan, Fig. 3. The front of the loom and especially the central portion thereof requires a higher degree of intensity of illumination than the rear, and for this reason the arrangement of lamps shown in the plan was decided upon.

The lamps are suspended 6 feet 3 inches above the floor and are completely hidden by the shades, as will be seen from the

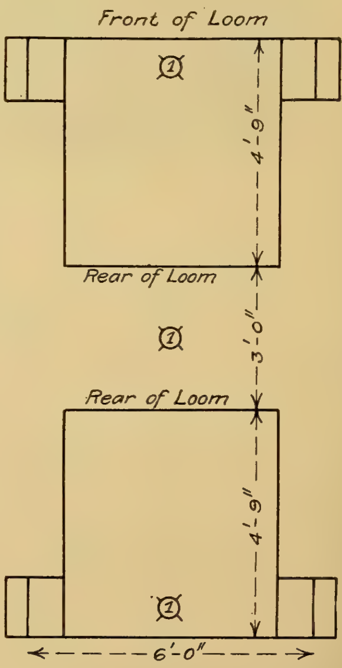


FIG. 3.—PLAN OF LIGHTING LOOMS IN NEW MILL, LAMPS FIXED.

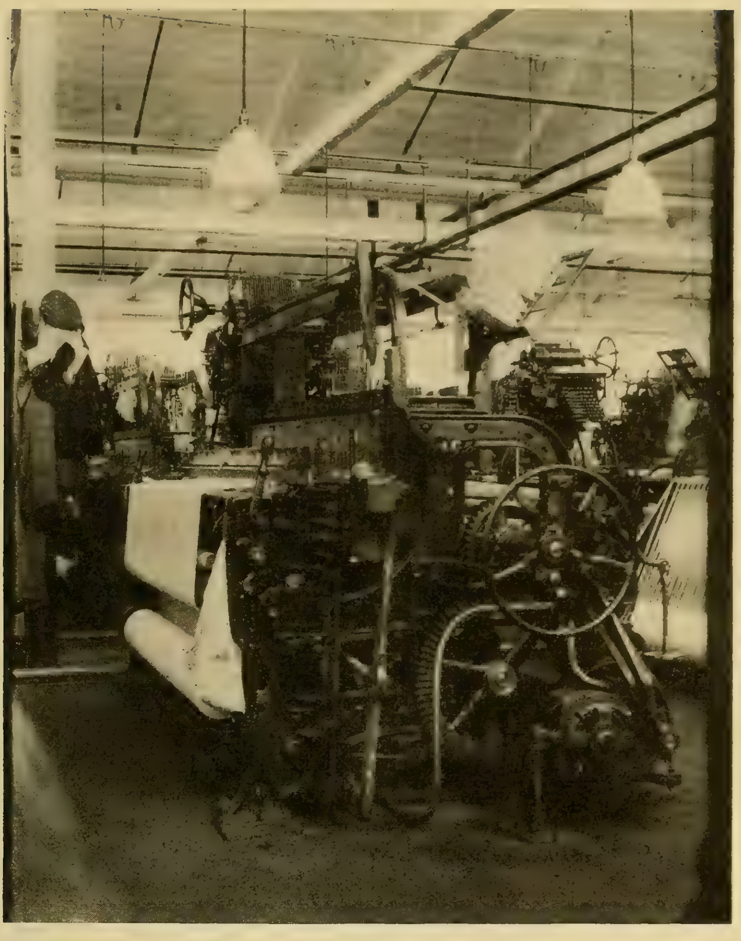


FIG. 4.—METHOD OF LIGHTING LOOMS, NEW MILL, LAMPS FIXED.

illustration, Fig. 4, which shows one loom and lighting equipment, and Fig. 5, which gives a general view of a portion of the weaving room.

Although the installation was made, as above stated, about two and a half years ago, before the American made tungsten lamp was on the market, the lighting design provided for the ultimate use of the tungsten lamp and the substitution of the latter for the G. E. M. lamp. In this connection the method of suspension of the lamps is of interest.

METHOD OF SUSPENSION OF LAMPS.

The lamps are hung from the ceiling by duplex reinforced cords containing No. 14 stranded wire. The weight of the lamp and shade is taken by a porcelain cleat by which the drop cord is fastened to the ceiling. This insures a simple and durable construction and a sufficiently elastic suspension to absorb any vibration or jarring caused by the operation of the machines.

LAMP AND POWER DATA.

In the following table the lamp and power data for equivalent areas of the old and new mill are compared:

	Old Mill.	*New Mill.*
16 c.p. (56 watt) carbon lamps	150	.....
75 c.p. (187 watt) G. E. M. lamps	....	116
Floor area (square feet)	11,400	11,400
Watts per square foot...	0.74	1.9

Watts per square foot (with tungsten lamps substituted for G. E. M. lamps)	1.02

It will be noted that the lighting design of the new mill provides for approximately two and a half times the power required for lighting an equivalent area of the old mill. This ratio holds for the G. E. M. lamp. For the tungsten lamp the ratio is somewhat less than one and a half.

In comparing the power requirements of these two systems of lighting it should be borne in mind that the systems are radically different and the quality of illumination produced by the one is wholly unlike and very far superior to that produced by the other. Moreover the actual quantity of illumination produced in the new system is much larger than in the old.

ILLUMINATION DATA.

Measurements of daylight and artificial light in these mills were made with a Sharp-Millar portable photometer containing a small tungsten lamp secondary standard.

The distribution of illumination over the working surface of the loom, which covers a space 6 ft. wide, is shown in the chart, Fig. 6. Illumination data giving intensity of general illumination, maximum and minimum intensity of artificial light, and minimum daylight intensity found sufficient for the work are given in the accompanying table:

	Old Mill.	*New Mill.*
Maximum intensity artificial illumination on machines—foot candles—horizontal	19.0	6.1
Minimum intensity artificial illumination.....	0.2	2.45
General illumination, intensity artificial illumination, center of aisles	0.11	0.845
Daylight, minimum intensity sufficient for the work.............	3.2	3.2

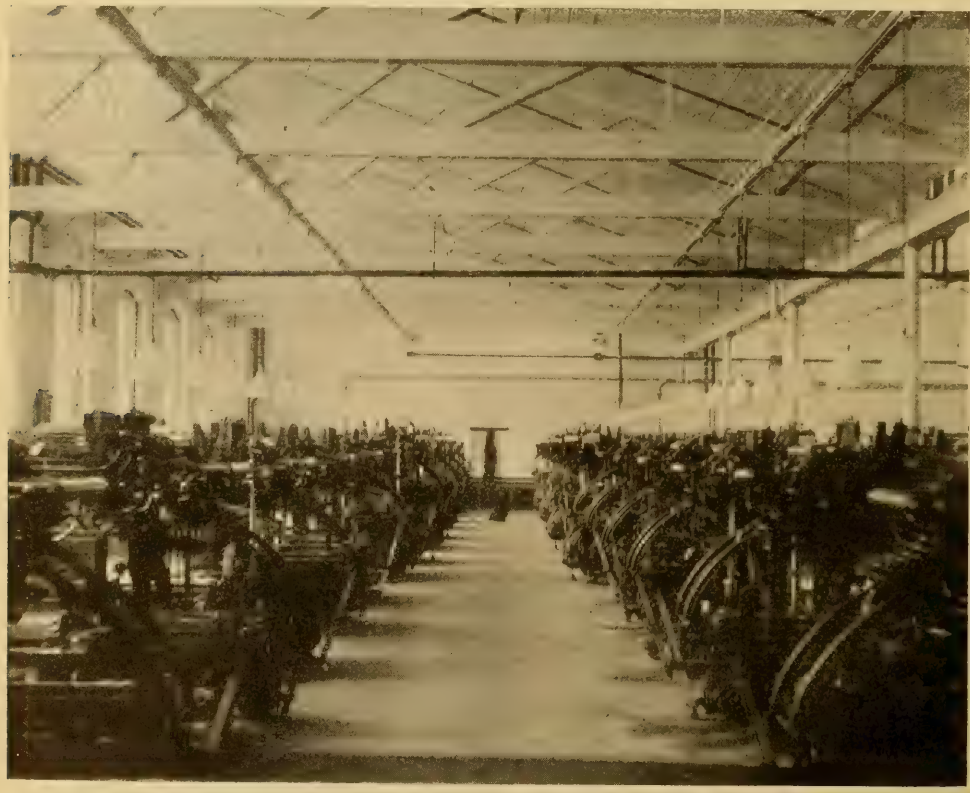


FIG. 5.—GENERAL VIEW, SHOWING LIGHTING EQUIPMENT OF WEAVING ROOM, NEW MILL.

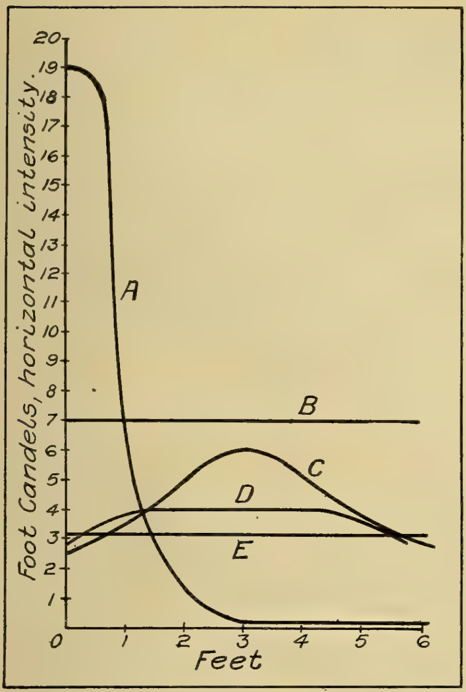


FIG. 6.—DISTRIBUTION OF ILLUMINATION ON LOOM.

DISCUSSION OF THE ILLUMINATION TESTS.

It will be noted from the chart that the distribution of illumination on the working surface of the looms in the new mill is fairly even, and that the distribution of illumination on the looms in the old mill is decidedly uneven. To secure good results in illumination it is absolutely necessary that the intensity of illumination should not fall below a definite minimum. In the old mill it is impossible to secure the requisite minimum simultaneously on all parts of the machine; to obtain sufficient light on the work the operator must actually shift the lamp along the length of the machine as the work progresses. In the new mill the lights are out of immediate reach and their location is permanently fixed.

The measurements show that in the old mill the intensity of illumination at one end of the working surface of the loom is nearly 100 *times the intensity at the other end. This wide variation occurs within a working space of only* 6 *ft.*

In the new mill the maximum variation between the most brightly lighted part of the machine and the dimmest part is about two and a half to one, a ratio which is well within the limits permissible.

Both the old mill and the new mill have a saw-tooth roof construction which provides for excellent lighting by day. Measurements made at 3 p.m. on a bright day (October 5) showed that the intensity of daylight on a loom near the end of the weaving room was as follows:

INTENSITY OF DAYLIGHT ON LOOMS.

	Foot Candles.
Bright day, 3.00 p.m.	7.
" " 4.40 p.m.	4.1
" " 4.55 p.m.	3.2

It was found that the minimum intensity sufficient for the work in daylight was 3.2 foot-candles. When the intensity of illumination fell below this point it became necessary to supplement the daylight by artificial light. An examination of the chart will show the contrast between the distribution of illumination on the machines in daylight and at night. The diffusion of illumination in daylight is perfect. The diffusion of illumination of the artificial light in the new mill, though far from approaching the ideal of daylight, is excellent. The illumination from the drop lights in the old mill is necessarily confined to a very small space with this system of lighting, and is not diffused over the working surface of the machine.

An examination of the table and chart brings out strikingly the fact that in the old mill the intensity of illumination on the machine, directly underneath the drop lamp, is more than two and a half times the intensity of daylight on the machine at 3 *p.m. on a bright day, and more than six times the minimum intensity that is sufficient for the work in daylight. At distances of more than* 3 *ft. from the light (or over a space covering one-half of the width of the machine), the intensity of the light from the drop lamp falls to about one thirty-fifth of the daylight intensity at* 3 *p.m., and to one-sixteenth of the minimum intensity required in daylight.*

In the new mill the maximum intensity of artificial light is less than the intensity of daylight at 3 *p.m., and the minimum intensity of artificial light on the working portion of the loom exceeds that of the*

minimum intensity found sufficient for the work in daylight.

In the old mill, little if any advantage is taken of the reflecting value of the ceiling and walls, whereas in the new mill this reflecting value is used to great advantage in the diffusion of the light.

Aside from the improved illumination on the looms resulting from suitable direction and diffusion of the light, there is an incidental advantage in increasing the intensity of illumination in the aisle spaces. In the new mill the intensity of illumination in the aisle spaces is more than seven and a half times that in the old.

In the old mill there is a strong glare from light reflected by the bright surfaces of the machines.

This glare reduces the sensibility of vision and causes eye strain. In the new mill the direction and diffusion of the light is such as to practically eliminate harmful glare.

Progress of the New Street Lighting

The movement for better lighting of the business sections of towns and cities is still pursuing the brilliant tenor of its way. One of the most noteworthy features of this remarkable renaissance in public lighting is the extent to which it has spread to the smaller towns, even those below the legal population requirements to constitute cities. Things are great only by comparison, and the town of five or six thousand inhabitants may have proportionately as great a "White Way" as New York. Measured by the proportion of inhabitants some of these smaller towns have completely outstripped the metropolis.

Here, for example, is a view down Broadway in Albert Lea, Minn., a town of some 6000 inhabitants, and another view showing the same street at night. The lamp posts are of excellent design, and the installation one of which the citizens may well feel proud—proud enough so that they will prefer to patronize their own enterprising merchants and business houses instead of wandering off after strange gods in other cities.

Columbia, S. C., is a city of some 26,000 inhabitants, and has recently lighted up its business section with tungsten lamp arches.

FIG. I.—ORNAMENTAL LAMP STANDARDS, ALBERT LEA, MINN.

FIG. 2.—NIGHT ILLUMINATION, ALBERT LEA, MINN.

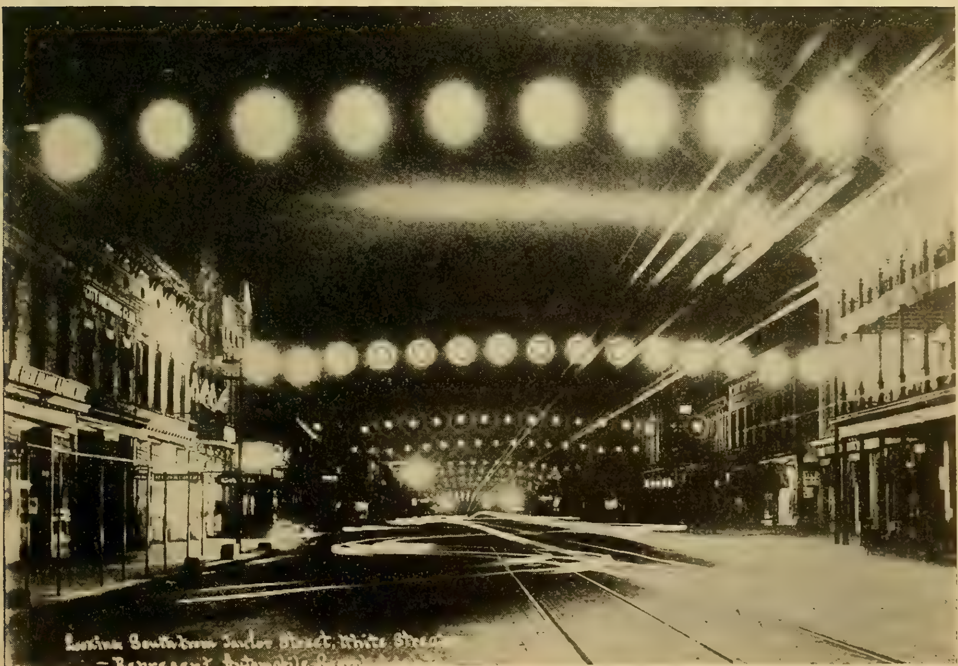


FIG. 3.—TUNGSTEN ARCH ILLUMINATION, COLUMBIA, S. C.

FIG. 4.—ANOTHER EXAMPLE OF TUNGSTEN ARCH ILLUMINATION, WILMINGTON, N. C.

Mr. William Elliott, the general manager of the local lighting company, gives the following description of the installation and the results produced:

A half mile of the principal retail section of Main street of Columbia, S. C., is illuminated with tungsten lamps arranged in arches. This illumination is very effective and has created a very favorable impression, both on the citizens of Columbia and visitors to the city. The merchants say that the number of people on the streets after dark since the illumination with these arches has increased beyond their expectations, and it is hoped that the lighting will extend to other blocks in the near future. The street illuminated is 100 ft. wide from property line to

FIG. 5.—PUBLIC SQUARE, WILKES-BARRE, PA.

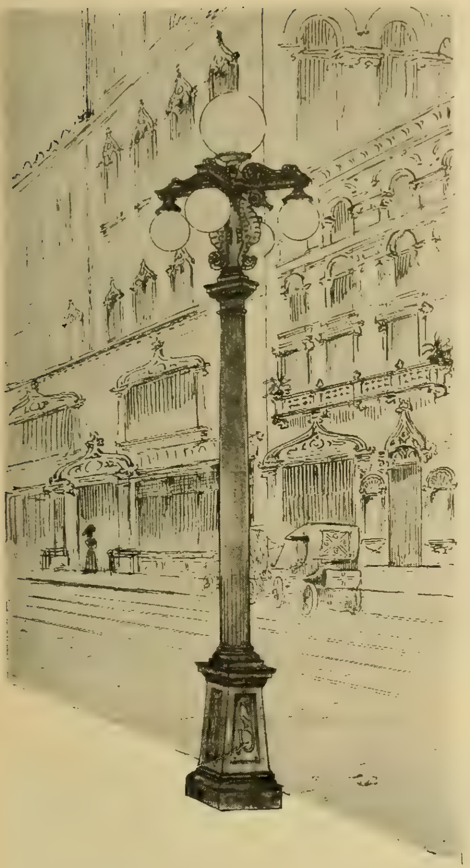


FIG. 6.—TYPE OF ORNAMENTAL STANDARD INSTALLED AT SPOKANE, WASH.

property line. The arches are suspended from ⅜-in. galvanized steel cables stretched across the street and anchored into the fronts of the buildings. The cable is attached at each end into insulated eye bolts that pass entirely through the front walls of the buildings with two nuts and a large washer on the inside. A turnbuckle is provided in one end of the cable to take out the slack. Strung on the cable are ordinary harness snaps with ring ends, and to these snaps are attached the insulating knobs from which the drops are suspended.

The drops are made up of different lengths so as to give the arch effect shown in the photograph. The snaps were used in order to remove the drops and connecting wires from the cable in case of trouble in the arch. There are seventeen 75 watt, 5.5 ampere series tungsten lamps to the arch, and two arches are operated in series at 460 volts. The regular street series socket is used and operates satisfactorily at this voltage. The films rarely fail to puncture when the lamp burns out.

Enameled steel reflectors are used over the lamps and the weight of the complete drops is carried on a single galvanized steel wire which relieves the conducting wires of all strain and avoids broken or loose connections.

The daylight appearance of the arches is pleasing. The construction is light and is hardly noticeable from the street below. The arches are spaced about 105 feet apart, and the lowest lamps, which are those over the sidewalks, are about 23 feet high.

Wilmington, N. C., is practically the same size as Columbia, in its sister State, and has also installed a system of tungsten arches.

Wilkes-Barre, Pa., is credited with 65,000 population, and has recently put in an installation of tungsten arches around its public square.

Spokane, Wash., numbers 80,000 inhabitants, and has shown its preference for the decorative lamp standard for its new installation. With true Western pride, both the design and execution of these handsome standards are by local talent, and an inspection of the illustration will show that the East has no monopoly on originality and taste in matters of public art. Describing this standard, the Gilmore-Goodwin Engineering Co., who did the installation work, says:

"The design embraces several appropriate features. Into the base of the column has been worked a symbolized representation of the 'Power City Falls,' with a conventionalized electric generator on each of the four sides. The brackets supporting the cross-arm are the conventionalized Sea Horse—symbolizing Water Power. Particular attention has been given to avoid unnecessary lodging places for dust and snow, and to produce a simple construction with as few parts as possible. The column is beautiful in proportion, having a correct entasis and being fluted. The entire Electrolier will be treated by the 'Carburet Bronze Process,' producing a beautiful bronze effect and a lasting finish to the iron casting."

Seattle, with a population of 276,000, has also adopted the ornamental standard with a rather unusual arrangement of lamps, as shown in the illustration.

Marching through Georgia, at least through the business section of its capital, to-day, is frought with far less difficulties than those that gave rise to the familiar marching song. Atlanta has its "Great White Way," which even includes a "flatiron building." The installation in

FIG. 7.—EFFECT OF SPECIAL STREET ILLUMINATION, SEATTLE, WASH.

FIG. 8.—ATLANTA'S "GREAT WHITE WAY" ILLUMINATED BY FLAMING ARC LAMPS.

FIG. 9.—ILLUMINATION BY FLAMING ARCS ON WHITEHALL STREET, ATLANTA, GA.

this case differs from all those so far mentioned in consisting of flaming arcs. That there is a literal blaze of glory is fully shown in the illustration.

In this brief sketch of progress we have passed from a town of 6000 inhabitants to a city of over a quarter of a million, and from eastern Pennsylvania to southern Georgia, and to the northwest extremity of our coast. This is an impressive demonstration of the extent, both in territory and in range of cities as to size and character of inhabitants, of this remarkable wave of sentiment for better public lighting. Let the good work go on.

The Business Side of Modern Street Illumination

By G. Brewer Griffin and F. H. Dimock.

(*Concluded.*)

The progress of the elimination of the Brush arc lamps and some of the enclosed arcs and substitution of metallic flame arcs is here given:

1909.	Metallic flame.	Enclosed arc.	Brush arc.	Total.
March	272	954	349	1,575
April	525	931	124	1,580
May	835	756	...	1,591
June	1,049	575	...	1,624
July	1,052	609	...	1,661
August	1,063	626	...	1,689
September	1,063	641	...	1,704

The full statement of arc lamp output for seven months of 1909 is as follows:

ARC LAMP OUTPUT.

1909.	Total hours.	Total No. lamps.	Arc lamp hours.	K.W. hours.
March	344	1,575	541,800	270,212
April	293	1,580	462,940	231,324
May	262	1,591	416,842	160,598
June	233	1,624	378,392	143,676
July	249	1,661	413,589	175,552
August	287	1,689	484,743	185,425
September ...	318	1,704	541,872	207,983

The last Brush arc lamps were cut out

on May 28. It may be here noted that, as shown in the comparative tables, the month of September shows an *increase of* 145 *lamps with a decrease in kilowatt energy* of 31,457 hours.

To bring out the results achieved, a direct comparison is desirable.

	Lamps.	Arc lamp hours.	K.W. hours.
March, 1908	1,554	526,806	263,403
March, 1909	1,575	541,800	270,212
Increase.	21	Inc. 14,994	Inc. 6,809
April, 1908	1,554	445,998	227,999
April, 1909	1,580	462,940	231,324
Increase.	26	Inc. 16,942	Inc. 3,325
May, 1908	1,554	400,932	200,466
May, 1909	1,591	416,842	160,598
Increase.	37	Inc. 15,910	*Dec.* 39,868
June, 1908	1,557	354,996	177,498
June, 1909	1,624	378,392	143,676
Increase.	67	Inc. 23,396	*Dec.* 33,822
July, 1908	1,559	386,632	193,192
July, 1909	1,661	413,589	175,552
Increase.	102	Inc. 26,957	*Dec.* 17,640
August, 1908	1,559	428,725	214,363
August, 1909	1,689	484,743	185,425
Increase.	130	Inc. 56,018	*Dec.* 28,938
September, 1908	1,559	498,880	249,440
September, 1909	1,704	541,872	207,983
Increase.	145	Inc. 42,992	*Dec.* 31,457

It should be noted in connection with the statement of lamps in operation that March and April were periods of substitution, and also noted that in July, August and September the number of enclosed arcs was increased by reason of demand for additional lamps on the circuits still thus equipped.

The small relative value of lamp hours and kilowatt hours in June is due to the short hours of darkness in that month.

Reducing the foregoing tabulation to its simplest form, we have the following results:

ARC LAMP OUTPUT, CONDENSED.

	Arc lamp hours.	K.W. hours.
1908.		
March to September, both inclusive	3,042,939	1,526,361
1909.		
March to September, both inclusive	3,240,178	1,374,770
Increase	197,239	*Dec.* 151,591

This shows for seven months, of which the first three were a period of change (the first metallic flame lamps were not cut in until March 17, two 75 lamp rectifiers being then put in service), an *increase of lamp hour output* for the entire system of approximately 6½ per cent. with a *decrease of kw. hours,* or power, of practically 10 per cent. If we consider the month of September alone the figures are more significant. Comparison shows an *increase* of lamp hours of over 8½ per cent. with a *decrease* of kw. hours or energy of approximately 12¼ per cent., and this notwithstanding the fact that 37 per cent. of the lamps in service were enclosed arcs of the type employed in 1908.

The saving in energy naturally resulted in a saving in boiler power and consequent reduction in expense.

The totals of arc lamp expense for June and July of 1908 and 1909 compare as follows:

LAMPS.

June, 1908	615	Brush arcs	1,557	$9,306.94
	942	Enclosed arcs		
June, 1909	1,049	Metallic flame	1,624	7,347.01
	575	Enclosed arcs		
		Increase	67	*Dec.* $1,959.93
July, 1908	615	Brush arcs	1,559	8,218.08
	944	Enclosed arcs		
July, 1909	1,052	Metallic flame	1,661	7,450.43
	609	Enclosed arcs		
		Increase	102	*Dec.* $767.65

FIG. 9.—METALLIC FLAME ARC ILLUMINATION, CITY PARK, NORTH SIDE, PITTSBURGH, PA. PHOTOGRAPHED AT NIGHT, SEPTEMBER 29, 1909.

While part of this saving was due to use of a better grade of coal at a lower price, the essential element was the fact that the decreased demand for power allowed the cutting out of one boiler, six supplying more lamps than seven could formerly furnish power for, allowing two to be held in reserve.

Another item of interest is the pay of lamp trimmers. Under the old system an average of six trimmers was constantly employed. When the metallic flame lamps were installed on fifteen circuits the life of trim was found to be, on an average, 240 hours, as opposed to 27½ hours for the open arcs and 110 hours for the enclosed arcs.

This rendered possible a 50 per cent. reduction of the force and the figures for pay of lamp trimmers for the seven months of the two years are herewith given:

LAMP TRIMMERS.

	1908.	1909.
March	$458.33	$409.09
April	408.38	250.63
May	405.00	154.38
June	383.25	150.93
July	410.00	224.69
August	428.62	212.50
September	430.00	235.00
	$2,923.58	$1,637.19

These actual results seem worthy of the consideration of not only every illuminating engineer, but of every central station manager whose plant is overtaxed.

The character and distribution of the illumination obtained is further shown in a second illustration taken in City Park. (Fig. 9.).

This photograph was taken after complete darkness, the sky showing reflection of surrounding lights. The two small clusters in the background are incandescents at the bridge end.

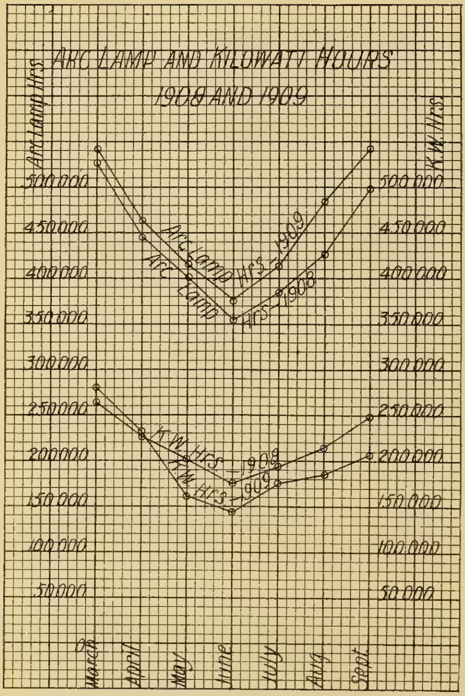


FIG. 10.—ARC LAMP AND KW. HOURS, 1908 AND 1909.

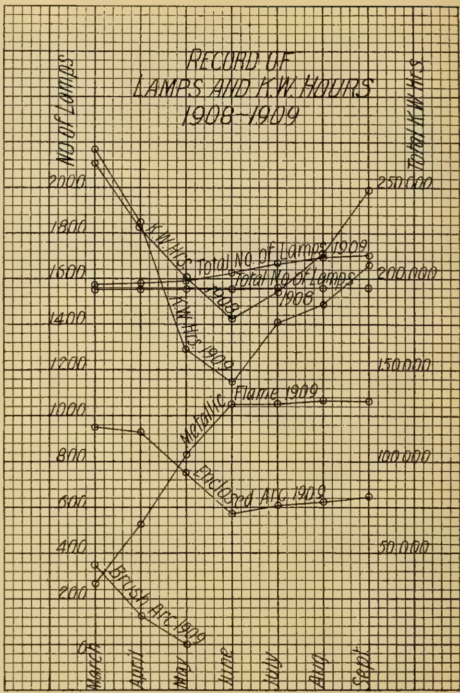


FIG. 12.—COMPARATIVE LAMP OPERATION AND KW. HOURS.

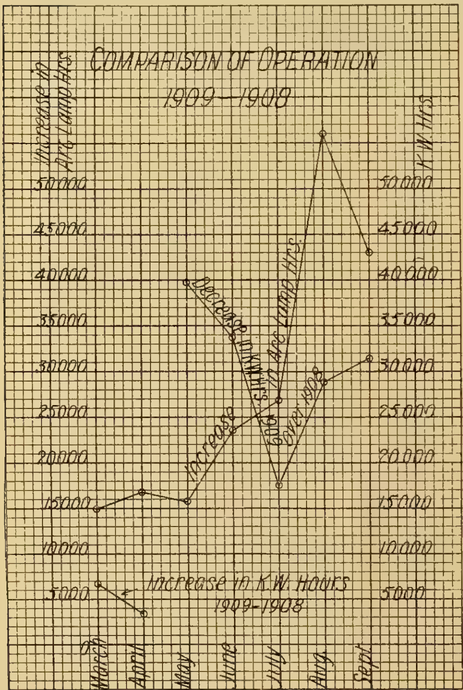


FIG. 11.—ARC LAMP AND KW. OUTPUT, 1908-1909.

Efficiency of various lamps upon test has been graphically shown earlier in these papers, and a similar method in illustration of the business side of illumination is employed in the diagrams representing the factors of input and output that we have been able to gather. (Figs. 10, 11, 12.)

The lamps have given general satisfaction and there has been no trouble with the system. Repairs have amounted to very little and the life of the bulbs of the mercury rectifiers has been very satisfactory, averaging far beyond the guarantee of the contractors.

We are informed by those in charge that if finances warranted they would gladly see the remaining enclosed arcs replaced by the new type; but their capacity has been so much enlarged that they can care for present demands without asking for further appropriation.

It would seem to us that Mr. Gray's recommendation and selection have been eminently justified and that the results furnish a basis for the answer to the questions instanced in the first part of these papers for many overloaded or inadequate plants. (*The End.*)

Sunlight and Artificial Light: A Comparison

By A. Cressy Morrison.

Part I.

It has been constantly claimed that each improved illuminant was the nearest approach to sunlight. Each enthusiast has concluded that the particular illuminant which attracted his attention was really a little spark of the sun. In order that all might be able to claim that a particular illuminant most closely resembled sunlight, we have found each advocating some especial theory that the eye sees best under certain conditions. As a result of the effort to find these conditions, the sun as a standard has been moved from one horizon through the zenith to the other. The shades of early morning as the rising sun lighted the world have been selected by some; mid-forenoon, noon, early afternoon and evening have each had their advocates. The sun has been placed in the south and in the north, and now there is no doubt that it will soon be discovered that the eye sees best at the North Pole. Moonlight has not been neglected either. Then we have the advocates of an obscured sun, the cloudy sky, a north light, an east light, to say nothing of the strenuous effort which has been made to prove that blue sky is the real thing.

In this way we have each discovered that our particular illuminant is actually and decidedly the nearest approach to the real standard—Old Sol himself.

Because artificial light is used mostly indoors, it has perhaps been the most natural thing in the world to make one of the tests of good seeing by any illuminant a reading test. I was gravely asked by an advocate of the blue sky as a standard to step first to a window through which the light came from the broad expanse of the heavens, with a book in my hand and see how clearly the type could be read, and then by way of contrast to take my position at another window, so that the full sunlight would fall upon the book, and see if I was not completely dazzled. The argument seemed conclusive until we remembered that the white paper of the book was returning to the eye practically all the direct rays of the sun which fell upon it, and that we were not looking at a white book on which was printed black type, but practically looking at the face of the sun itself. This fact has been overlooked by some of the greatest among us. Then the larger fact dawned upon us that the question of good seeing was not a question of reading indoors. We realized that the world had been reading for but a comparatively few years and the adaptability of the eye to highly civilized conditions had been extremely slow as compared to the advance of civilization itself.

It is probable that the human eye has been developing from the time that the first micro-organism became sensible to the longest visible red rays and awakened to the difference between temperature and light. In the estimation of the time which has elapsed since the first living organism reacted to light, we can choose between the first man and date the Garden of Eden about 6,000 years back, or go back to the first glimmer of the sun's radiance, which some astronomers estimate at 18,000,000 years ago, or we can choose the estimate of the geologist who placed the time one hundred or more million years ago. However, unless we accept the Garden of Eden, we must admit that the evolution of the human eye has been in progress through untold ages and that since man, as such, has been evolved, he has been a diurnal animal. Had he been nocturnal, his eyes might react to other rays than those of the visible spectrum; his little octave of light might have been extended in both directions. Therefore, to test the eyesight by any of the indoor requirements of modern civilization is but to test the adaptation, admittedly great, of the wonderful mechanism of the eye: that is, the optical adaptation of a daylight animal.

Any test which throws the rays of the sun back into the eye is practically looking at the sun itself, and while this may be a splendid optical test for eagles, who are said to look at the sun without flinching, it is quite out of the range of our ability.

It would seem probable that when man awakened in the early days and crept from beneath the shadow of the overhanging trees, or later emerged from his cave or his darkened habitation, that his eye rested upon the green trees, fields and the blue water or upon the reddish brown earth, and that these primary colors were contrasted not only with each other, but with the flowers of the field and the gaudy plumage of the birds and insects. As the eye became more accustomed to the daylight, animal life on land and in the sea, in spite of its ingenious adaptation to the color of its surroundings, became more visible. It is more than probable that coincident with the evolution of the human eye there have gone forward two processes: first, the color of the flowers, since trees and plants have begun to bear them, have evolved more brilliant shades and contrasts, and, second, imitative adaptation in the other direction has developed greater harmony between animal life and its surroundings. The bird of paradise has from dull beginnings evolved his gorgeous plumage. Thus, as the human eye has advanced to see the prismatic colors in all their beauty, these colors themselves in nature have become clearer and more beautiful to look upon. In the other direction, the animals upon which man has subsisted have become in many cases so closely adapted to their surroundings that the eye must indeed be sharpened if man was to live.

The great belt of the temperate and tropic zones has been man's principal habitat. In summer, when most light was needed, the sun was highest in the heavens, and in winter, when the snow cap of the Arctic circle advances into the temperate zone, and the trees have lost their leaves, the sun has retreated south or north and the dazzling whiteness is less trying. It is a strange thought, is it not, that the Eskimo who faces the blinding sun during a seven-month day has five months of darkness in which to recuperate the tired muscles and rest the optic nerves. The human eye, by its power of adaptation, modifies the minor differences and leaves true the broad statement that it is best adapted to see in full daylight when the sun is at the zenith, when there are no objects which throw rays directly back into the eyes, and when the eyes are looking from beneath the shadow of the head and eyebrows out upon the fields, the forests, the mountain crags and the rippling water. Then all objects send to the window of the soul the true spectral vibrations to which they respond, unmodified and as perfect as the day itself.

With a view to ascertaining exactly the color values of the spectrum of the sun, on the 23d day of June, 1909, a clear day, in our own country, I asked the Bureau of Standards of the Department of Commerce and Labor at Washington, D. C., to conduct a series of investigations—first, upon the sun itself and then, using the sun as a standard, upon various artificial illuminants, that it might be ascertained beyond peradventure which of these illuminants was nearest to sunlight, whether any were near to sunlight and how far man must go in the improvement of all illuminants before he literally produced sunlight at night. The results of this investigation are now being tabulated, and in a succeeding article I shall find pleasure in announcing the conclusions, which promise some disappointments, some surprises, much food for thought and a basis for ambitious effort on the part of illuminating engineers and physicists who, I have found, have much further to go than any of us suspected.

Part II.

In considering the approximation of any illuminant to sunlight, the experiments which were conducted by the United States Bureau of Standards at my suggestion, under the very skillful direction of Dr. Herbert E. Ives, were confined to the visible spectrum.

The visible spectrum is, as we are all very well aware, but a modest fraction of the total radiations of any illuminant, natural or artificial. At best, then, a comparison of the visible spectrum of an artificial illuminant with the visible spectrum of the sun, is merely indicative, and should an artificial illuminant be found to be identical in the visible spectrum with the sun, it might or might not be identical from the standpoint of optics, chemistry or biology. There are several well known facts which should, however, be mentioned in this connection.

We are told that the ultra violet rays produce active chemical effects. The photograph is an illustration. A red glass—the only monochromatic glass we have—inhibits the passage of the ultra violet. It must be conceded, therefore, that the red rays (if producing any chemical effect) produce an effect quite different from the ultra violet. It is also well known that the infra red rays, which will penetrate a black paper absolutely opaque to the visible spectrum, will produce growth and even complete fruition of plants, in some instances with slight modification, but usually with profound effect upon their structure.

It has also been observed that certain visible portions of the spectrum produce practically opposite effects, and that in a complete spectrum these opposite effects tend to neutralize each other. In a badly balanced spectrum, therefore, even the visible rays might produce strange results because left unneutralized. One popular illuminant which lacks entirely certain important vibrations has been shown to distort plants growing under it as badly as it distorts colors. Can man escape these abnormal effects if long exposed to them? Taking these well established facts together, it must be recognized that the visible and invisible light combined make the total spectrum of all illuminants, and that any attempt at the approximation of an artificial illuminant to the radiations from the sun must take both into consideration.

It is a well established fact that plants depend for their respiration upon the invisible rays and that the chemical changes which produce their color values are caused by the rays of the visible spectrum. It therefore becomes clear that any conclusion which is to be reached as to the proximity of an artificial illuminant to sunlight must include an observation to some normal process of nature involving life itself, as, for instance, the effect of light upon the growth of plants which can be watched from birth to maturity. If experiment should show that an artificial illuminant, which in the visible spectrum closely approximated sunlight, but under which abnormal effects were produced upon plants, we must conclude that the resemblance does not extend through the entire spectrum but is chiefly confined to those vibrations of which the eye alone is cognizant. If, on the other hand, an illuminant closely resembling sunlight is found to also produce normal plant growth, it must be concluded that, so far as indications go, its approximation to sunlight continues throughout the spectrum, and by inference, at least, it might be concluded that this approximation made it the best for human beings.

There is no doubt whatever of the physiological effects of light, both visible and invisible, upon human beings. We have found it in optics, in medicine and psychology. There is room therefore, for a series of most ingenious experiments, which, properly conducted, might point in the direction of the one ideal illuminant, and as a mere suggestion might lead to a system of illumination by which selected rays might be utilized for different physiological or psychological purposes. An amusing thought would be a "happiness" light for a theatre devoted to comedy and a "tragic" light for a harrowing performance. We are all the time unconsciously making this very selection, and lighting effects are produced to emphasize the mental impression which we desire to convey.

The investigations conducted by the Bureau of Standards upon the visible spectrum disclose the fact that the claims of all those who have declared that a particular artificial illuminant was "a spark of the sun itself," have let their enthusiasm carry them further than the cold figures seem to warrant. Here again it should be remembered, however, that only the visible spectrum has been analyzed by the Bureau. The open flame illuminants, gas, kerosene and the candle, fall into a class by themselves and are farthest from sunlight. A notable exception is acetylene, which stands in a class by itself as the only open flame illuminant which meets the extremely rigid tests of full equality in the visible spectrum to the highest attainments in electricity and incandescence. The carbon filament lamp is also in a class by itself, for it falls, even when burning under the best conditions, into an approximate parallel with

kerosene and open flame gas. The arc light approaches the others very closely and would be an undoubted claimant to very high honors, were it not from an abnormality in the violet. The tungsten lamp, which is the highest and most modern development of electrical effort, stands on a parity with acetylene as far as the visible spectrum is concerned, and, sharing the honor, the mantle burner can properly claim a place slightly closer to the sun than either. Optically, the mantle light, because of its greater radiating surface, is considerably ahead of an equal candle power of the tungsten light, and this advantage will undoubtedly give it prestige where an effect upon the eyes is seriously considered. But, the invisible light radiated by artificial illuminants must be taken into consideration. The data, while by no means complete, is sufficiently so to be very interesting and suggestive. It has been found, as is well known, that photographs may be taken through substances opaque to the visible rays. Experiments also show that by the exposure of certain substances for ten seconds to sunlight, these substances will thereafter give off invisible rays sufficiently strong to affect a photographic plate in complete darkness eighteen months later.

Some extraordinary effects of reflected rays are shown by the effect of moonlight upon animals and the suspected connection between the effects of light and strange mental states, as illustrated by our word "lunacy." Various curious effects upon insects of lights of different colors have been demonstrated by experiments on ants and even micro-organisms. The destructive effect of light upon some bacteria—the effects of light, visible and invisible, upon germination and subsequent growth of vegetable organisms and innumerable other illustrations come to us from the efforts of the world's greatest experimenters. All these illustrations go to demonstrate that the advent of civilization, which has made the use of artificial illuminants a necessity, has brought into play subtle forces, which may, in time, as profoundly modify the race as they are known to modify plants, producing amazing abnormalities.

Giving consideration then only to those artificial illuminants which have been found to belong to the highest class, we can say definitely that electricity has not proved itself advantageous in the development of plant life. The electric arc, for instance, stimulated plant life to a certain point and then injured the growth and produced an abnormal result. The conclusion reached in the Cornell experiments, lasting some three years, was that the electric light was not adapted for plant growth. So far as the writer is aware, no experiments have been conducted with tungsten light to ascertain its effect upon plant life, so that the value of its invisible spectrum is problematical. That its effect optically is very trying, must be generally admitted.

As regards the mantle principle, it is believed that the invisible spectrum has not yet been investigated. As regards acetylene we have valuable data from the Cornell experiments covering a period of years, and the conclusion reached was that "Between 90 and 95 per cent of the plants experimented with responded favorably to the stimulus given by acetylene light." This would certainly imply that there were no abnormalities in the invisible spectrum of acetylene, and as its visible spectrum is at the very apex of modern attainment, the overwhelming evidence of its effect upon plant life leads inevitably to the conclusion that acetylene is really the nearest approach to sunlight which man has made.

FIG. I.—METROPOLITAN TOWER, SHOWING TIME FLASHER AT TOP OF TOWER.

A Remarkable Tower

Towers mark the efforts of the city to lift its head above the deadline of humdrum existence. They arise into an atmosphere unsullied by the breath of contentious trade and the exhalations of perspiring strife. The tower is to the city what the mountain peak is to the landscape; and about their summits still linger the mists of romance and tradition. It was in "many-towered Camelot" that the fair lady of Shellot wove her mystic web. A tower is a personality. It has eyes and a voice, and frequently a beckoning hand continually reminding us of the flight of time. Its eyes, like those of the fabled dragons, send forth their own light, and its voice runs the whole gamut of human joys and woes. It calls the bride to the altar, and tolls the last summons of the dead; it calls the maidens to prayer and worship, and the youths to war; it mingles with the din of mid-day traffic, and breaks the solemn stillness of the night.

It was for the purpose of providing for the all-seeing eye of light, and the resounding call of the bell, that towers came

into existence; and while it may serve some of the commoner purposes of human life, a tower without its bell or clock has something incomplete and gruesome about it, like the eyeless sockets in a skull.

The tallest tower in the world to-day rises at the corner of the Metropolitan Building, at Madison avenue and Twenty-fourth street. We do not consider the Eifel Tower, which is, properly speaking, not a tower at all, but a mere succession of platforms set upon stilts. The Metropolitan Tower is wider than a church door and deeper than a well, for it occupies the entire site on which formerly stood the church made famous by the fiery sermons of Dr. Parkhurst, and its foundation extends a hundred feet below the pavement. The architect had "the courage to be simple," with the result that the lines of the tower are majestic, graceful and thoroughly pleasing. The pinnacle of the roof, which is 700 feet above the pavement, is terminated by a huge octagonal lantern in which are placed tungsten lamps aggregating over 22,000 candle-power. Midway between this and the pavement, on each of the four sides, is a clock face 26 feet in diameter.

When the New York skyscraper first made its appearance it was a conceit of the humorist to show the future building of this kind with clouds floating about the upper stories. This is actually realized in the case of the Metropolitan Tower; it is not uncommon, when the low fog clouds drift in from the ocean, to see the upper part entirely enveloped in clouds, while the main building and the space below is quite clear.

The clock is in some respects the most remarkable timepiece in the world. The minute and hour hands weigh respectively 1000 and 700 pounds each, and are 17 and 13 feet respectively in length, while the figures on the dial are 4 feet high. The hours are struck on a bell weighing three and a half tons, with a 200-pound hammer. Beside the immense bell there is a fine set of chimes. The clock mechanism in the tower is operated by electricity. Besides these gigantic dimensions, the clock is unique in utilizing light as a means of announcing the hours and quarters. The quarters are announced by one, two, three or four red flashes, and the hours by the appropriate number of white flashes. The figures on the dial, as well as the hands, are outlined with electric lamps, so that, by the combined use of sound and light, this giant of clocks announces the time visibly or audibly to one-sixteenth of the population of the United States.

Toward the close of the afternoon in these dark, short days, when practically every window in the tower is alight, the spectacle presented is of the most impressive beauty, as may be conceived from the illustration shown. The white marble of which it is constructed, illuminated by the many windows, stands out against the dark firmament like a veritable "pillar of light by night."

In height and grandeur, and in the unique features described, the Metropolitan Tower is emblematic of the supremacy of modern science as the genius of American life.

We are indebted to the publicity department of the General Electric Company for the figures given above.

John Trumbull Marshall

Among the charter members of the Illuminating Engineering Society there was one whose gentle manners, genial temperament and forceful but modest speech impressed its personality upon all those with whom he came in contact. This was Mr. J. T. Marshall, long connected with the Photometric Department of the Harrison Lamp Works of the General Electric Company. The following sketch of his life and character has been furnished us by the company, of which he was long a faithful and highly-esteemed employee:

John Trumbull Marshall, assistant engineer of the Lamp Works, died in Bermuda, January 1, 1910, aged 50. He was a direct descendant of Jonathan Trumbull, the American patriot, friend and adviser of Washington, and Colonial Governor of Connecticut.

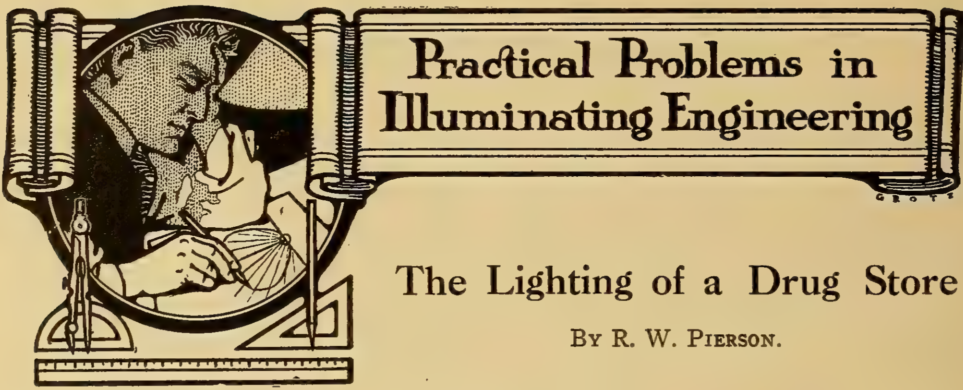
Mr. Marshall graduated from the scientific course of Rutgers College in 1881, and went to work at the Edison Lamp Works, then at Menlo Park, in October of that year. His first work was in connection with the photometry and life testing of lamps, and he always maintained a special interest in these subjects. He in 1883 or 1884 invented the comparison method of photometering lamps. Practically all our carbon lamps are to this day measured for voltage by this method, which is very simple and enables an unskilled operator to measure a large number of lamps per day.

During the last few months Mr. Marshall completed and put in successful operation a very remarkable development of the comparison method of lamp measuring. This is known as the Watts-per-Candle Photometer. The ones now in use in the factory give the volts, amperes and candle power of a tungsten lamp at the desired W. P. C. The only electrical instrument used in connection with this photometer is a zero galvanometer; with this also a constant voltage line is not necessary. Only one operator per photometer is necessary and the output per operator, as well as the accuracy of the work, is much greater than by the older method which entailed the use of a constant voltage line—a volt meter, an ammeter and a slide rule calculation for each lamp.

Besides specializing in photometry, Mr. Marshall has paid much attention to the manufacture of carbon filaments, especially methods of carbonization, and the practical methods of metallizing filaments at present in use are largely methods which he worked out. Mr. Marshall was a good mathematician and made all the calculations on which manufacturing data on lamps were based. He had a very large capacity for work and used his capacity to the limit.

JOHN TRUMBULL MARSHALL.

Personally Mr. Marshall was universally loved and respected. A man of strong character and convictions, in him truthfulness and straightforwardness were so well developed that he was incapable of the least degre of deception. He signed a total abstinence pledge when a boy and never broke it. He lived a very simple life and found his recreation and enjoyment in his garden, the woods and the fields. He knew the trees, plants and flowers growing in his neighborhood, and had many of them domesticated about his home. He was unmarried and devoted his life to his parents, who have died in recent years, and to his sisters.



The Lighting of a Drug Store

By R. W. Pierson.

The accompanying plan, Fig. 1, and illustration, Fig. 2, show the general lighting equipment of a modern drug store, which the manager and wiring contractor considered adequate, and "the best possible."

This store is situated on a corner opposite the campus of one of the large Eastern universities, and is much frequented by students, with a good class of non-college customers in addition, and is thoroughly up-to-date in its line.

Considerable remodeling has recently been done, including a new front, with four large windows 8 ft. high, new soda fountain, cases, shelves, counters, etc. The latter are of golden oak, the fountain is of white marble, except the mirror frame and posts, and the walls and ceiling of light buff. Over and in front of the fountain's mirror (shown by crosses) are six receptacles, equipped with "tulip-shaped" colored glass shades, hanging straight down.

The store proper is lighted by two four-light and four two-light combination fixtures, arms 18 in. long, lamps at 45 degrees; height above the floor 7 ft. 8 in. The former are equipped with four 40-watt clear tungsten lamps, and four open-tip gas burners, with distributing prismatic reflectors for the tungsten lamps, and etched shades for the gas.

The manager figures that since he has no electric sign he needs a two-light (combination) fixture in front of each window, low enough to be seen from a distance, to attract attention and pull in the strollers. From the sidewalk these fixtures appear to be about 18 in. below the top of the plate glass.

If more than a superficial examination

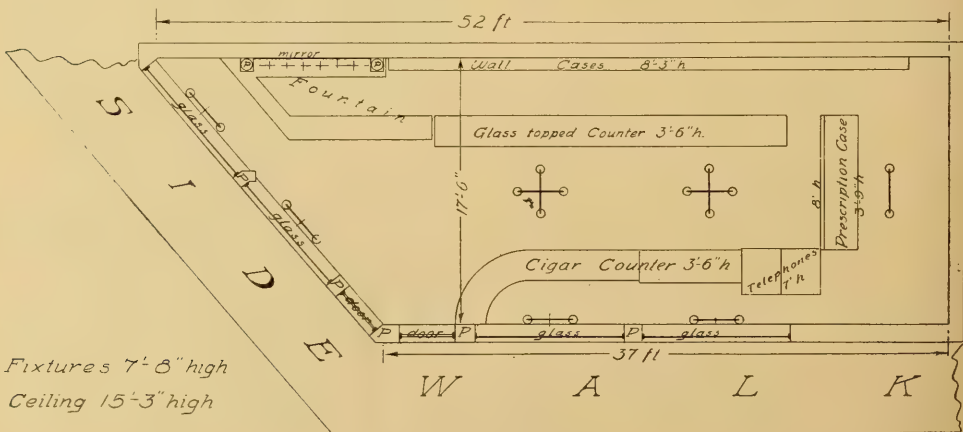


FIG. 1.—PLAN OF STORE.

FIG. 2.—THE DRUG STORE, SHOWING EFFECT OF NEW ILLUMINATION

of this installation be made, it will be found that the ceiling outlets are properly placed, *i. e.*, the most light is on the prescription counter and cigar case—the principal objection being to the low height, clear lamps and the angle of same.

The rear section, where prescriptions are compounded, appears to be well lighted, though a more economical arrangement could doubtless be devised.

The front part of the store, with an area of 647½ sq. ft., with a total of 640 watts tungsten, should give 4½ to 5 foot-candles, but the store does not seem as bright as other places having that intensity, as measured by illuminometer.

Indirect Lighting in a Library

The accompanying illustration shows part of the main reading room of the John Crerar Library of Chicago. The room was formerly lighted by direct illumination, but this proving unsatisfactory to the management they were led to make a trial installation of indirect lighting. This was done in what is called the Senn Room. This room is used particularly for scientific and medical works, and the trial installation resulted in such favorable comment from the physicians, oculists and ophthalmologists who use this room largely that the board changed the entire installation throughout the library from direct to indirect illumination.

The various departments lighted included this Medical Reading Room, the Main Reading Room, the Catalogue Users' Working Space and the Public Catalogue

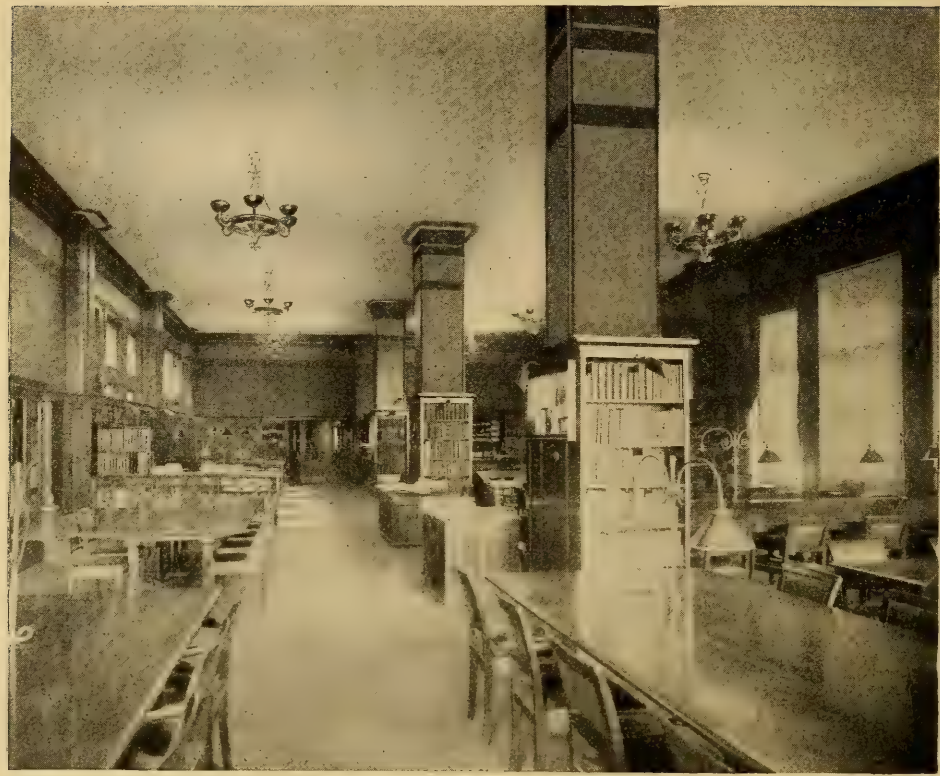


FIG. I.—A PORTION OF THE JOHN CRERAR LIBRARY, CHICAGO, SHOWING AN INSTALLATION OF INDIRECT ILLUMINATION BY PLACING THE ADAPTABLES OR UNITS ON THE ARMS OF THE FIXTURES PREVIOUSLY USED

Card Room. The results are eminently satisfactory, and the favor with which it is received by the public shows that this method of illumination is eminently adapted to public libraries.

The ceiling, which is 17 feet high, was finished in a grayish-green color, as proposed by the architects, Shipley, Rutan & Coolidge, who thought best, from an esthetic standpoint, not to make the same of an extremely light color. A lighter color would undoubtedly have resulted in greater efficiency, although the results with this treatment, as stated, are perfectly satisfactory and prove conclusively that for successful results in using this method of illumination it is not absolutely essential to have a white ceiling, or a ceiling of an extremely light color. It should not be inferred from this that gray, green or any dark color is desirable, it being a well recognized fact that the absorption by light in these cases is greater than if the ceilings are finished in light colors, not necessarily white, but light cream and light yellow being preferable.

Owing to motives of economy which must often be taken into consideration, in the Main Reading Room, as illustrated, it was found that the old fixtures already in use could be utilized according to engineering specifications for installing these indirect lighting units; that is, the arms were the proper distance from the ceiling and of such a nature that the necessary apparatus could be easily placed thereon. It is to be remembered in all installations that correct engineering in placing the outlets, and designing the reflectors, and specifying their distance from the ceiling, is very essential to obtain the best results. In this instance the outlets and fixtures

happened to be admirably adapted to the system. In this instance not only was economy effected by the use of the fixtures already in place, but the units placed on the arms balanced very nicely, and the result was an attractive fixture.

The equipment in the Main Reading Room formerly consisted of eight chandeliers, having six arms each, and table lighting consisted of 24 table uprights. The southwest wing of the Main Reading Room, which has recently been added, is illuminated with one six-arm fixture similar to those shown. The Senn Room comprises a space of 1200 square feet, being in size 60 x 20. The indirect lighting system consists of 10 three-arm fixtures. The working space comprises 800 square feet, being 40 x 20, and contains eight two-arm indirect lighting fixtures. This space is used for illuminating titles and doing all kinds of miscellaneous clerical work, as well as containing files holding the records. The Catalogue Room is a long, narrow room, 10 x 25 feet, and contains five two-light fixtures, and was a difficult problem for any method of illumination, the walls on two sides of the room being largely glass and dark wood trim. It is well known that wherever daylight and any artificial illumination have to compete, it is a difficult problem.

In this case the engineering problem required considerable study, and the installation, which consisted of the concentrating type of reflector, installed 12 inches from the ceiling, resulted in the reflection of the light from the ceiling at a sharp angle, bringing it down to the working plane without excessive loss on the side walls. It is a peculiar feature of indirect illumination that in many cases where ceilings are of unusual height and are comparatively small it necessitates the placing of the reflectors close to the ceiling. The results are particularly pleasing in this room, and one can work with great facility in the numerous card index files with which this room is principally filled. With any system of direct illumination in such a room a person would be working at a disadvantage, much of the time being in their own light. With this method of illumination the even distribution of light enables every file to be examined without any disagreeable or annoying shadows.

The results in the Main Reading Room, as stated, are eminently satisfactory, the public appreciating the soft, evenly diffused and comfortable illumination. Many of the readers have taken occasion to compliment the management, both verbally and through the public press.

As to the cost, in comparison with direct illumination by tungsten lamps, which system was replaced, the cost is approximately the same. In comparison with the carbon filament lamps used some 18 months ago, Mr. C. W. Andrews, the librarian, states this indirect system of illumination is about 33 per cent. cheaper.

A Successful "Home-Made" Reflector

By E. J. Mora.

The illuminating engineer is often called upon to design reflectors for special purposes that are not found in the market. The writer was called upon to design a reflector to be used over the operating table in a local hospital, the requirements being cheapness and such design as not to cast any shadow below the reflector. After investigating it was found that there were reflectors on the market for this purpose, but they did not meet both requirements, being either too expensive to meet the doctor's pocketbook or allowing certain shadows to be cast when an object was placed beneath. The method of solving the problem was as follows:

A sheet of tin 2 x 4 feet was bent into a trough, having as nearly as possible a parabolic form in cross section. This can be accomplished by drawing a parabola of the required focal length, and then sawing a wooden templet from a piece of board from this curve. A parabola is a mathematical curve which can be drawn by a method of tangents. The focus

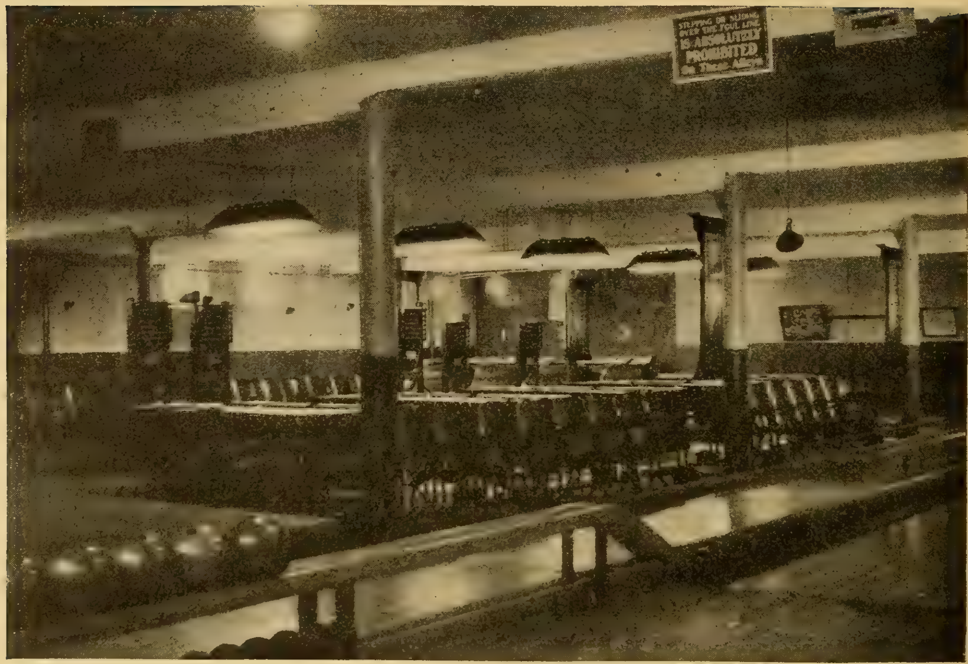
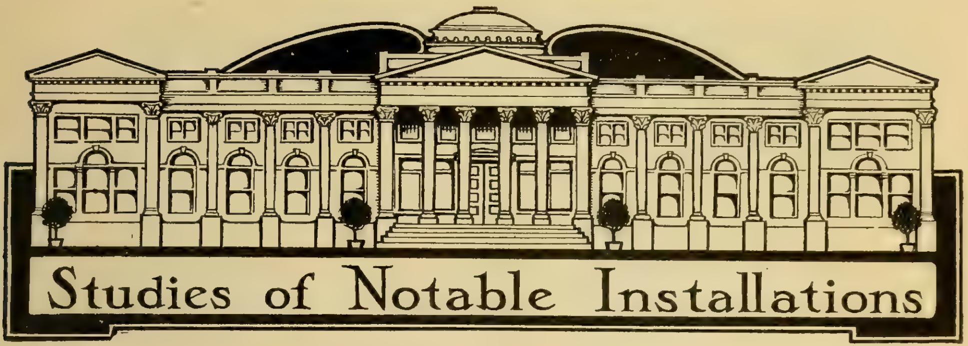


FIG. I.—REFLECTOR APPLIED TO BILLIARD TABLE ILLUMINATION.

should be taken as the center of the filament of the lamp. The method of drawing a parabola may be found described in books on mechanical drawing and in works on analytical geometry. Having formed the tin into this shape, it was screwed fast to a strip of hard wood 2 inches wide and 1 inch thick, at the apex of the curve. In this wooden strip three holes were bored at equal distances apart, in which were inserted from the back porcelain sign receptacles. The ends were closed with pieces of tin bent into parabolic form, thus completing a reflector having parabolic sides and a parallelogram shaped opening. The tin was turned in to a right angle around the open edge, making a ledge upon which was placed a sheet of ground glass. Three 100-watt tungsten lamps were screwed into the sockets, which were properly wired, and a strong screw-eye placed in the end of the wooden strip furnished a means of suspending the reflector from the ceiling.

The reflector was painted white on the outside and the total cost was about $4. Ventilating holes were provided so as to carry away the heat from the lamps. The coefficient of the reflection of polished tin is about 70 per cent. and the absorption of the ground glass about 15 per cent. The ground glass gives a perfect diffusion of light beneath, preventing all streaks and shadows, and also prevents the glare of filaments from striking the eyes of the patient.

The device was found so satisfactory for use in the hospital that an installation was later put in for billiard table lighting, a view of which is shown in the illustration. The requirements for this class of illumination are practically identical with those of the operating table, and the device proved equally satisfactory.



Some Special Cases

Lighting installations, like men, may be notable for defects as well as virtues. They have this also in common with men, that they are seldom hopelessly bad or perfectly good. The novel owes its universal popularity to the fact that it criticizes human nature from an impersonal standpoint, contrasting the good with the bad, in order to bring these qualities out more effectively. While the names of persons and places may be fictitious, the exposition of human nature must express truth from the point of view of the writer, or his work is useless. An impartial study of different lighting systems with a view to frank criticism and comparison is one of the best of all methods of acquiring that facility of judgment in matters of illumination which constitutes "common sense," that much vaunted and supposedly rare accomplishment. Careful observation, retentive memory, and a habit of analytical reasoning are the basis upon which experience builds the structure of skill which is above rules and formulæ. With these preliminary reflections, let us now examine a few special cases of lighting that are noted for the prominence of the positions which they occupy.

There is a general impression that expenditures made by the Federal Government are unstinted with reference to the particular objects of expense. To this rule, however, there are many exceptions. On large enterprises Uncle Sam is inclined to be lavish; but it would surprise many to know how niggardly and impecunious he can become on matters of expense that are comparatively the merest trifles. Generally speaking, the buildings occupied by the Government in Washington are handsome and expensive structures, particularly those of a more recent date. Undoubtedly the most beautiful of all the Government buildings is the Congressional Library. This is not only the finest of our own Government buildings, but the most magnificent library building in the world. If we may digress for a moment into the field of political economy, we may call attention to the fact that this exquisite and magnificent piece of architecture was built under the supervision of the War Department, and on its completion some $100,000 of the original appropriation by Congress remained unused, and was turned back into the Treasury. The total cost was somewhat less than that of the Hall of Records, built by the City of New York. Those who are familiar with the two buildings can readily draw their own conclusions as to the relative economy of city and national government.

Generally speaking, the artificial illumination of the Congressional Library is seriously defective. The interior architecture and decoration is exceptionally fine, being rich in material and elaborate in design. We will take time here to comment upon one of the least objectionable of its lighting features. Fig. 1 shows a view of the grand stairway, which is of exquisitely sculptured marble, with a fine bronze figure surmounting the newel post. While this statue might very properly have been a piece of pure art, it has been

FIG. I.—THE GRAND STAIRWAY, CONGRESSIONAL LIBRARY, WASHINGTON, D. C.

converted into a lighting fixture and thus made ostensibly utilitarian. The figure is holding aloft a torch, which is a fitting symbol of the intellectual light of which the building is such an exceptional repository. This symbolism, however, has been sadly battered by the use of a cluster of modern electric lamps in the place where the flame of the torch should be. This is a kind of crudity in art which finds a parallel only among savages and barbarians. It is of the same order as a parody of the Sermon on the Mount, or playing ragtime on a pipe organ. There is no necessity, to begin with, for using this statue as a lighting fixture. The finish is of white marble, and the problem of general illumination, therefore, an exceptionally easy one. The figure is far too fine a piece of work to be condemned to the commonplace duty of holding up an electric lamp. The symbolism of the torch should have been retained with the strictest possible conformity to tradition, by either an actual flame of gas, or the closest possible simulation, by means of an electric lamp in a flame-shaped yellow opalescent globe. This is by no means an isolated example of such misuse of the torch emblem. The present fad for classic architecture has given rise to such anachronisms in abundance.

The Capitol building is generally conceded to be one of the most dignified and satisfactory pieces of classic architecture

in the world, and this applies generally to the interior as well as the exterior. Fig. 2 is a view of the famous marble room. An attempt has been made here to carry out the general decorative features in the lighting fixtures. The chandeliers are elaborately ornate and massive, and the extent to which they obscure the magnificent vista which would otherwise be presented by the Corinthian columns is plainly shown; they are overdone and obtrusive. Considered in themselves they at once suggest the query, "Why all this profusion of sculptured metal to support the half dozen poor little electric lamps, which stand bolt upright in pristine nakedness without so much as a leaf to cover their bases?" The metal work is out of proportion to its actual and ostensible purpose—*i. e.*, of supporting light-sources and their accessories. Instead of this wilderness of metal hanging from the ceiling, obscuring the perspective and obliterating the fine sculptured capitals of the columns, how much more effective would have been a system of side brackets of simple but harmonious design. Dirt has been defined as "matter out of place." There are a good many dirty lighting installations.

The real labor of Congress is done by the committees, and the different committee rooms therefore constitute the workshops of our law-makers. It would be no

FIG. 2.—THE FAMOUS MARBLE ROOM IN THE CAPITOL, WASHINGTON, D. C.

FIG. 3.—TYPICAL COMMITTEE ROOM IN CAPITOL, WASHINGTON, D. C.

great perversion of terms to class the illumination of these committee rooms under the head of industrial lighting. They are particularly important installations, not only on account of the character of the work done, but also that so much of the work is done by artificial light. Fig. 3 shows a typical committee room in the Capitol Building. That there is a sufficiency of light generated is at once apparent, the chandelier being equipped with eight 32-candlepower lamps on the arms and under the central reflector. The position of the lamps and the entire lack of diffusion, however, is about as bad a combination in its effect upon the eyes as could well be devised. From every part of the room almost the entire number of these lamps can shine directly into the eyes. Such industrial lighting as this ought to be prohibited by law, just as would any other dangerously unsanitary condition. A sufficient amount of exposure to this lighting would ruin the strongest of eyes.

The wonder never ceases that atrocities in illumination will be accepted without a murmur, where the best results of modern science could be had for the asking. The parsimonious actions of the Government do not extend to matters which directly affect the comfort of the people's representatives. The committees of Congress could have practically any kind of lighting which they would ask for. An illuminating engineer should be included among the Government officials, and he should have absolute authority and be responsible to no one but Congress itself. The office should be included in the Civil Service list, so that his selection would depend upon his fitness for the position. This is by no means the only example of bad lighting among the Government buildings, the older buildings in particular are full of just such cases.

In contrast with the almost glaring simplicity of this room and its lighting appliances, the committee room shown in Fig. 4 is conspicuous for its magnificence. It is hard to say, however, in which case the lighting is the worst. Here we have a most lavish display of art metal in the form of chandeliers, but in point of illumination there is nothing better than the bare incandescent lamp in an upright position. It is one of those numerous cases in which utility has been almost entirely forgotten in a mistaken effort to secure art. It is small comfort, indeed, to look up at a piece of chiseled bronze with eyes smarting from glare and a head aching from eye-strain. More comfort and less art is the better way.

FIG. 4.—ONE OF THE FINEST COMMITTEE ROOMS IN THE CAPITOL

Fixtures and Accessories

The Relation of the Architect to the Illuminating Engineer

A Suggestion in Harmony With Mr. Albert Wahle's Article in the October Issue of THE ILLUMINATING ENGINEER

By George Pugh Smith

Some months ago an article over my signature appeared in The Illuminating Engineer, making as its principal point the obvious necessity of a working knowledge of the primary principles of architecture, decoration, balance and color, to the success of the profession of illuminating engineering. The reading of Mr. Albert Wahle's article in the October number prompts a repetition of the fundamental ideas then set forth, with a few additions as to possible methods and the like.

My theory in a nutshell is this: Illuminating engineering is aiming to do more than merely furnish an adequate number of foot-candles to properly illumine a given space—it is aiming, as I understand it, to increase human comfort through the proper combining of light and commonsense by making the places illuminated more pleasant to live and do business in.

Necessarily—and here I repeat what I said before—if illuminating engineering is to achieve more than a passing success it must take into consideration harmony, color and the basic principles of applied design. For, unless these points are made one in the application of the new science, how is it to achieve results which will do more than furnish just the right amount of light for the case in hand? No rational man will maintain that simply lighting a space accurately affords sufficient ground for a science to stand upon; it must with its proper amount of light give the proper fixtures, and to do this it must understand how the harmonizing designs are worked out. If these points are essential, how is the engineer to obtain the necessary knowledge of them if not by constant study of the best which has been and of the best which is, with reference to architecture and its kindred arts. In other words, how do you expect to apply what you know to be necessary to change an ugly spot into a place of beauty unless you understand the principles of constructional design?

Again, how do you expect to designate the fixtures, which may be a part of the decoration of a "period" room, unless you know the particular style of decoration germane to that particular period? While I—and I believe all men interested in better decoration—abhor the "epoch" idea, still in order that we may not commit anachronisms, we must study the works of those who have gone before.

Granting that all periods are composite, it follows as a sequence that we must understand not only one particular epoch, but the single ideas and the ideals which called it into being.

To whom shall we turn to get at these very necessary points?

The architect is the logical person, since in his studies he will have thoroughly familiarized himself with design and style since time began, and in his files will be found data, drawings, photographs and the like which will have material bearing on the subject in hand.

The idea, then, is to associate ourselves with the architect, so that he will consider us as much an essential to his whole as he does his experts on fireproofing, concrete and structural iron.

The question next arising is, "How are we to accomplish this association?"

In the first place I should advise that where possible the illuminating engineer make application to the local architects' society or club. He will, in all probability, be rebuffed unless he has had a talk with a number of the more prominent architects beforehand and explained to them that by such an association his knowledge of what is proper in lighting would be enhanced and his technical knowledge would be of inestimable advantage to them in any event. Again, the illuminating engineer is usually one to fifty in proportion to the architects of a given community, and in such a case there should be a warm reception awaiting him at the hands of the architects.

Outside of the great metropolitan centers the illuminating engineer is more a myth than a reality, for as yet there are so few men devoting their time and energies to illumination that the smaller communities know little or nothing of them, and will naturally be a little backward about acknowledging them and giving them recognition. It is to just this class of illuminating engineers, those whose profession is carried on in the smaller cities, that I want to make the following suggestions, for they more than those of their co-workers in larger fields need the assistance which every little bit of artistic and practical knowledge can give them. They will have the hardest time making their science recognized by the architects, since these latter men will know less of its aims, achievements, ideals and causes than do the architects of the great cities.

To these latter illuminating engineers I would strongly advise that they make it a point to meet and know personally every architect in their community; that they go to each and ask questions, show interest in the work of each, and ask for suggestions. An architect is a man who takes pride in his work and who is striving to make it individual—as a consequence he will grasp at a chance for enhancing that individuality when he is convinced that the chance is a good one. And who is there to say that by a better selection of fixtures and a better arrangement of lights the work of the architect will not be improved?

Get the architects to show you all the drawings they have—study them with reference to period and usefulness in your business—ask the architect to suggest to you the kind of fixtures he has in mind, for you will find that he has a general idea, and ask him to make rough sketches of those ideas. Then you submit them to a fixture house and the draughtsmen there will return to you drawings which will be along the ideas you offer.

Another way: In every city I have visited there is a public library; in each of these collections there will be found books and copies of famous paintings in which will be found ideas galore of fixtures for lighting purposes. Study them. Learn the different styles peculiar to the different periods and the reason for each. Make sketches of your own along the lines in the pictures; then have the fixture man's artist work them up; or suggest them to the architect with the idea that they will be better for both parties concerned in their modified form because they will be called upon to bear modern light sources and to answer modern illumination and decoration questions.

If there is to be a decorator in the work you have in hand have a talk with him. He knows, or should know, what is right, and you could do no better than keep in touch with him.

Above all things I say to illuminating engineers, unless you have studied proportion, design and ornament do not attempt to specify fixtures. Take your plans to your architect and ask his advice. Don't be ashamed to go to such a man, for remember he has put in a lifetime of hard study on these three points. You cannot expect to know what he knows unless you study, study, study—proportion, balance, line color, ornament and their application. These are as essential to your success as are your formulæ for computing an installed illumination. The more you learn of these essentials to modern architecture the more you will be a success in your own line.

Therefore, let me repeat what I have said and let me urge upon every man who preaches the gospel of better light to take care of what he does and to take care of what he avoids in specifying his fixtures. A working knowledge of balance, line, harmony, application, building and their kindred arts is absolutely essential to your success as an illuminating engineer, for your work is dependent upon them, as is the bettering of their work dependent upon you.

Therefore, get into close touch with the architect by making him understand that you want to meet him upon his own ground by absorbing his ideas, by showing an interest in his work, by acting upon his advice.

Study. Every piece of work you do will be either good or bad—if it is good it is perfect—if bad there is an imperfection somewhere and the chances are nine to one that it will lie in the marring of your own work by improper fixtures, colors or groupings. Study these points and once the mistake is made see to it that it isn't repeated.

Rome was not builded in a day. Neither can you expect to learn all the esthetic points of your profession in a few years' study of one side of it. Keep at it then. Only study with some one who knows. That man is the architect. He is your logical collaborator. Upon his work depends yours, and upon yours depends the making or marring of his labors. Then meet that architect; say to him frankly and honestly that you need his artistic advice as much as he needs your technical knowledge, and both work together for the betterment of your kind. Herein lies the success of illuminating engineering.

The Renaissance of Combination Fixtures

By George Wilfred Pearce

A large revival in the demand for combination fixtures is noted by the trade in New York, New England, Pennsylvania and Ohio. A recent tour of those areas by the writer exhibits that the demand is general, with especial activity in southern Pennsylvania, New Jersey, Connecticut and Massachusetts. In the towns of New Jersey, along Long Island Sound, and on Long Island, that are popularly called fashionable, many well to do houseowners who a few years ago displaced gas for electric fixtures, have recently put in combination fixtures. Gas and electric light companies in the above mentioned sections say that more and more their patrons are using both kinds of illuminants. Several high class architects who specialize in dwelling houses say that the marked return to the use of combination fixtures is due to the general opinion held by women of mature years that they look better under gas light than where none but the electric light is available for social functions. An architect of several thousand dwelling houses in the Oranges, Montclair, Morristown and other residential areas in New Jersey, says that about ten years ago he made up his mind that combination fixtures had had their day and were passing away. Of late a revival occurred, and in nearly all instances he is now specifying combination fixtures. For forty fine residences in Park Avenue, East Orange, now under construction, this architect originally designed none but electric fixtures, but as one by one the houses were sold, the buyers asked for combination fixtures, and these are being supplied. One of the oldest fixture manufacturers of the country says: "The revival in the demands for combination fixtures is due to the belief of women of mature years that they look better by gas than by electric light or wax candles, and also to the general awakening of the latent art sense in many women whereunder they give very much more attention to the artistic decoration of their homes than their mothers and grandmothers did. This has brought about the displacement of many crudely designed electric fixtures set up in the days of the infancy of electric lighting by tyros in the engineering

field, who had no knowledge of fixtures as art work in metal, and who made an upset price for wiring and fixtures in which the same low grade of fixtures was submitted to the owner of a house worth $50,000, as was in general use for lighting market stands and factories. In those days most householders supposed that the patents on the electric lighting system also covered all forms of electric lighting fixtures, and that makers of gas fixtures who advertised that they made electric fixtures did not make the genuine articles that would properly distribute the new light. That idea was encouraged by many of the vigorous young electrical engineers of that day who had to work hard to get any business in lighting away from the powerful gas corporations and interests allied therewith. In the early days of electric lighting few women bought fixtures. That field of domestic buying was almost wholly committed to men of the family, as had been the case for many years before in the gas fixture business, wherein most of the sales to the final buyers were made by plumbers and gas fitters, whose shops until recent years were places where women were seldom seen. As a traveling salesman for my father, I covered for thirty years twenty-six states, selling gas fixtures, and in the latter years in that work I added combination and electric fixtures. In all those years I am sure I did not see a dozen women in the shops of plumbers or gas fitters choosing fixtures. The fathers and husbands attended to that business for their women folks. Nowadays, nine-tenths of the lighting fixtures that pass to the final buyers are selected by women, and that one fact accounts, in great part, for the uplift into the atmosphere of art in fixtures that has been evolved in recent years. Women do not like the scrawny, spindly and bizarre electric fixtures that were so common a few years ago. They like to see handsome, well proportioned and massy fixtures depended from ceilings and affixed to walls, and they know that they get superb lighting effects from a combination fixture. I noticed at my home some time ago that one of my daughters had lighted both the gas jets and the electric bulbs in the hall and parlor. I told her to turn off one or the other, as I was not rolling up wealth for the public service corporations, if I could economize. She said, "Oh, pa, it is the real swagger thing nowadays to have both kinds of lighting on at the same time for evening receptions; one gets very fine effects on the gowns and ornaments of the ladies by using gas and electricity." I appealed to my wife to condemn that idea, but I found that she was of the opinion of the children, and I had to stand for it, and I guess that's the way with most fathers.

Virtue could see to do what virtue would
By her own radiant light, though sun and moon
Were in the flat sea sunk. And Wisdom's self
Oft seeks to sweet retired solitude,
Where with her best nurse, Contemplation,
She plumes her feathers and lets grow her wings,
That in the various bustle of resort
Were all-to ruffled, and sometimes impair'd.
He that has light within his own clear breast
May sit i' th' centre and enjoy bright day;
But he that hides a dark soul and foul thoughts
Benighted walks under the midday sun.

MILTON: *Comus.*

The Annual Meeting of the Illuminating Engineering Society

There are two events in the calendar of the Illuminating Engineering Society which are of special note and of general interest to the illuminating engineering fraternity. These are the convention, and the annual meeting.

Contrary to rather general custom, the important business of electing officers does not take place at the society's annual convention, but at its annual meeting held in January. Thus far the candidates selected by the committee on nominations have been elected in each case with practical unanimity. This may be taken as indicating that the nominating committees have always presented an acceptable ticket, and that politics have not yet had a place in the conduct of the society. It is to be hoped that this condition will continue indefinitely.

Surely a better selection for president could not have been made than that of Dr. E. P. Hyde. His fitness for the position is of a many sided nature; while not a practicing illuminating engineer, Dr. Hyde's familiarity with the theory of the subject in general, and his distinguished abilities in the important subject of photometry are such as to honor the society in his election as president. His numerous and valuable contributions to the subject while connected with the Bureau of Standards, and the very important part which he had in securing the adoption of an international candle-power standard are matters of record. His present position in charge of the Research Laboratories of the National Electric Lamp Association places him in a position to pursue the line of work for which he has shown such pre-eminent abilities, the results of which will reflect credit upon the illuminating engineering profession in the future as it has in the past. Dr. Hyde has been one of the most heartily interested members of the society since its foundation, and his contributions among the most valuable parts of the proceedings. He is an exceptionally clear cut and impressive speaker, though making no pretensions to oratory, and his elucidations of scientific topics are models of scientific writing.

It is naturally expected that one should say complimentary things of the incoming president, but the task is not only an easy, but a pleasant one, when this can be done with a clear conscience and with all sincerity, as in the present case.

It is an equally agreeable task to commend the administration of the retiring president, Mr. W. H. Gartley, on the excellent progress of the society during the past year, both in the number and character of the members added, and in the quality and extent of the papers presented. Mr. Gartley took hold of the office with a vigor and enthusiasm which could have no other result than infusing some of the same qualities into the society in general. His greatest service was undoubtedly in bringing the importance of the science of illuminating engineering to the attention of the gas lighting interests, who have not been so ready to accept the new science as their electrical competitors. To Mr. Gartley must be given largely the credit of having brought the two predominating lighting

interests to a state of adequate equality of representation in the society. If there was ever room for suspicion of partiality toward the electrical lighting interests in the society they have now vanished, and the fact is demonstrated beyond question that illuminating engineering as a profession is as impartial and unprejudiced as that of any of its confreres.

The re-election of Mr. Preston S. Millar as general secretary is a worthy tribute to the large amount of work and careful thought he devoted to the interests of the society during the past year.

The report of the finance committee is gratifying. It shows that the society has a very neat surplus of over $4000 in its treasury, and that it was practically self-sustaining from its regular sources of income during the past year. By regular sources of income are meant membership dues, sale of proceedings, etc., as distinguished from advertising patronage. Altogether a profit of several hundred dollars for the year were carried over to the surplus account.

Owing to the exceeding inclemency of the weather, which was the high peak of a blizzard, the attendance at the meeting was somewhat less than had been expected, there being about fifty present. A dinner was held in the rooms of the Machinery Club, after which the usual order of business was carried out.

The Relation of Illuminating Engineering to Gas Lighting

Now that the British Illuminating Engineering Society is an established fact, it will be interesting, both on general principles and for the points which we may gather applicable to our own country, to watch the progress of the younger society. Apparently one of its greatest difficulties is going to be to keep its reputation for impartiality clear. Of its actually conducting its affairs in an unprejudiced manner there is no doubt; but to such tension is competition between gas and electric light drawn in England that it will indeed be remarkable if the society can keep its poise in the minds of those two competing interests. Already the gas people are complaining that the society has a preponderance of members from the electrical persuasion. The remedy for this is very simple and obvious, viz., for the gas interests to immediately join the society. With the general alertness of the English gas fraternity it would be a curious spectacle indeed to see the electrical interests get the lead in this important movement, as they unquestionably did in this country.

The *Gas World* of January 1 discusses the situation in a thoroughly practical and logical manner, and much that it says will apply to our country as well as to England. As to the field for this new science and profession the writer says:

> If such a society is really necessary, it is obvious that it cannot be a serious factor in the choice of illuminants for various purposes until the illuminating engineer who has not only a professed but a real impartial knowledge of all illuminants has "arrived." At present, the chief drawback to his arrival is that the "practice" is not there, but must be created. Before it can be created the "British public" will have to be educated to the point of conviction on two things; he will have to be convinced that he is not able himself to decide the right form of illumination for his residence and his business premises, and he will have to be convinced that a fee paid for impartial advice will be a good investment. It may be further said that he will have to be convinced that the advice *will* be impartial.

This statement is, of course, of universal application, and applies to the American Society quite as much in the beginning as it does now to the British Society. The four years of public education that have elapsed since the founding of our society have been highly satisfactory to the educators, and equally satisfactory to the educated. Where illuminating engineering has been practiced, even with the necessarily imperfect skill incident to a new art, it has resulted in such great economies, and in so much better quality of results as to amply justify the profession.

As to choosing between gas and electricity as the luminant, that is seldom a question to seriously confront the American illuminating engineer. Either the conditions of the particular problem in hand, or the client's wishes, decide the matter without question. Choosing between the different forms of electric lamps, however, is one of the common problems encountered. The question of the engineer's impartiality, therefore, is rarely put to the

test by the two great luminants, gas and electricity, but rather by the rival claims of the different types and makes of electric lamps and accessories; and even here the decision is often forestalled by conditions or preferences, so that, so far as the engineering is concerned, it is very often narrowed down to the problem of securing the best qualitative results with the greatest economies possible with a particular form of lamp, such, for instance, as the tungsten lamp, the flaming arc, or the mercury vapor lamp. Much of the illuminating engineering in this country has been done, and doubtless will continue to be done, by engineers connected with the different manufacturers of lighting apparatus. This, as we have pointed out before, is a perfectly legitimate phase of illuminating engineering, the client in each case understanding fully that he is getting expert knowledge only so far as the particular make of apparatus is concerned.

On this question of partiality our contemporary draws some inferences from the treatment of the two luminants in THE ILLUMINATING ENGINEER:

> One is led to these reflections by an observation of what has happened with respect to the periodical known as THE ILLUMINATING ENGINEER, published in New York with the avowed intention of treating the subject of "Illumination" with impartiality. Taking the last number (November), it is observed that of its total of 58 pages only 5¼ are devoted solely to gas lighting, 9¼ concern both gas and electric lighting, and 38 apply solely to electric lighting. It cannot be said that, even in America, this proportion adequately represents the relative importance of the gas industry to illumination problems. Yet this journal claims to be the mouthpiece of the American illuminating engineer, and to it may be ascribed the birth of the British periodical bearing the same title. When the majority of the articles are contributed by gentlemen who are electrical rather than gas lighting engineers, the paper or periodical in which such articles appear cannot be free from the suggestion of bias, unless it is shown that the excess treatment of electrical matters is approximately in proportion to the relative magnitude of the two industries.

We have no wish to appear to defend ourselves against the very courteous and apparently logical conclusions of this writer, but a little further analysis of the situation will throw a somewhat different light upon the subject. There are a number of reasons why gas lighting does not occupy the attention of THE ILLUMINATING ENGINEER to an equal extent with electric lighting. Some of these depend upon fixed conditions, and others upon conditions produced by the gas interests themselves. In the first place, a clear distinction must be drawn between the importance of gas lighting as shown by its relative money value, and its importance in reference to illuminating engineering problems. Gas lighting in this country is almost exclusively confined to the smaller installations. Its stronghold is the private residence, a position which, as we have before pointed out, it holds by the logic of the situation, and which it will continue to hold until electricity can compete with it for heating and cooking purposes. It is evident that these smaller installations do not present important engineering problems in illumination, any more than the average residence presents an important architectural or structural engineering problem. The number of small buildings and residences, of course, vastly outnumbers the large factories and skyscrapers, but it is the latter that give employment to the engineering professions. Furthermore, gas lighting to-day involves the use of practically a single lighting unit—the mantle lamp—whereas electric lighting involves the use of a long list of lamps each having such essential peculiarities as to practically unfit it for certain purposes, and giving it compensating advantages for others. Both in the character of the problems presented, and the means to be employed in solving the problems, therefore, electric light affords by far the larger field for engineering service. This is no disparagement to gas as an illuminant. On the contrary, it might be argued that gas was the superior on account of its far greater simplicity. These, then, are the fixed conditions which primarily determine the relative positions of gas and electric light in illuminating engineering.

As to the artificial conditions, so to speak, the gas interests in this country were not so alert in foreseeing the great movement toward better illuminating practices which took concrete form in the establishment of illuminating engineering as a science, and the Illuminating Engi-

neering Society as its organized exponent. This condition, however, has been rapidly changing within the past year, so that at the present time the society is substantially equally divided in its membership between the two interests. The gas companies are also making decided progress in the way of utilizing the science to their own ends.

It is interesting, and we trust will be instructive to our younger brother society, to note that in the four years' existence of the American Society there has never been the slightest feeling, expressed or otherwise, that either interest was being fostered at the expense of the other. The representatives of all the lighting industries have met side by side, have discussed their various problems with the utmost freedom, impartiality, and invariable good feeling, with the result that each has been largely benefited. THE ILLUMINATING ENGINEER has been assiduous in its efforts to secure matter pertaining to gas illumination, and has persistently pointed out the advantages to be gained by the gas industry in promoting this new science. Now that the gas interests are taking hold of the matter in earnest we shall doubtless have more contributions that will be of general use to the profession. Meanwhile the profession itself continues to progress and develop in a manner to cheer the hearts of all interested in its welfare.

Legislating Against Public Improvements

It would be folly to maintain that any legislator ever consciously and voluntarily votes for a law which would impede public progress and improvement; but it occasionally happens that laws or ordinances enacted for the purpose of securing the greatest good to the greatest number, and preventing individual encroachment upon public safety or convenience, when carried out in accordance with the customary practice of lawyers, proves to be a stumbling block in the way of certain lines of progress rather than an assistance. This is particularly likely to occur with laws that are allowed to remain on the statute books after progress in the arts and sciences have radically changed the conditions under which the laws were enacted.

A case of this kind is the city ordinance regulating the placing of signs and street lamps. The hanging of ordinary sign-boards promiscuously over the sidewalks from the front of buildings can manifestly become a serious public nuisance, and therefore falls within the legitimate domain of public regulation. In some cases such regulation has gone to the other extreme and prevented a full use of the modern electric sign, which did not exist when the original regulations were enacted. In these days, when every city and town is striving to produce the most conspicuous "Great White Way", all ordinances which by any possible construction can be used to frustrate this laudable purpose should be at once wiped off the statute books, or properly amended.

A peculiar case of such obstructive legislation recently came up in Hartford, Ct., admittedly one of the most beautiful cities in the Western Hemisphere, and justly proud of the distinction of being the richest city, per capita, in the United States. A certain progressive hotel proprietor asked permission of the Board of Street Commissioners to place two ornamental lamp-posts on the curb in front of his hotel. The matter was referred to the corporation counsel, who advised the commissioners that they had no authority to grant such permission, as the act was prohibited by a certain ordinance to which he referred. It has been said that the quickest way to obtain the repeal of an obnoxious law is to rigidly enforce it. While this may be true, such heroic treatment entails more or less hardship. There is a principle in common law that a statute which in its action turns out to be contrary to the public good thereby becomes inoperative. Thus, a contract between two parties which would prevent or hinder either party in the regular pursuits of life by which he is enabled to provide for his support is void; and it is now common law, based upon court decisions, that a provision in a will which is contrary to the public good, or entails injury to individuals, is to that extent without force.

It is conceivable that an ordinance to prevent the obstruction of a side-walk by placing fixed objects along the curb might

be necessary; but when such an ordinance operates to prevent such a manifest and undisputed public improvement as the placing of efficient and ornamental lamp-posts in a reasonable number and position along the side-walk, it seems that it might very properly be adjudged contrary to the public good, and so made inoperative in such cases. The better way, of course, would be the modification of the ordinance so as to encourage such public improvements as the one which is now denied; even such legitimate evasion of the literal interpretation does not increase respect for law.

If the case in Hartford is effective in calling attention to such ordinances as will insure their repeal, or modification, it will serve a valuable purpose. It is unthinkable that the City Council, or the Board of Commissioners, should actually wish to oppose the placing of these lamp standards. The Commissioners unquestionably wish to act in accordance with the law, and may rightly hold themselves blameless for any injury or injustice which may result from such adherence to the city ordinances. That the actual effect of their decision, however, is contrary to the best interests of the city can be no less plain. The Board of Street Commissioners may be assumed to have ample judgment as to the number and position of lamp-posts which would add to the utility and effectiveness of the street illumination, and the matter of the placing of such posts might be left with perfect confidence to their judgment. The particular ordinance in question, which takes such authority from the Board and prevents the improvement of their streets, cannot be repealed too soon.

The Illumination at the Chicago Electrical Show

The lighting is necessarily the most spectacular feature of any electrical exhibition. While other uses of electricity are interesting and commercially important, it is the electric light that appeals to the multitude, and it is the multitude to which the electrical show always caters.

The Chicago show has always been notable for the novelty and originality of its illuminating schemes, and this year is no exception. The illumination has been distinctly divided into two classes: the useful and the spectacular. The former is of a localized nature, being provided by lamps on the corner posts of the booths and domes hung above, each provided with imitation art glass shades and tungsten lamps.

The spectacular lighting is produced by projecting powerful searchlight beams lengthwise of the auditorium, from the ceiling of which are suspended showers of ribbon and tinsel streamers. The effect produced is beautiful in its shimmering iridescence and mystical in its methods of production, giving the whole room the air of an Alice-in-Wonderland palace.

The spectacular lighting is due to that wizard of the searchlight, Mr. W. D'A. Ryan. An exact description of the installation will be of interest to illuminating engineers. The streamers are suspended at distances of from 2 to 4 feet apart, the entire number being about 3500. The tinsel streamers are equally divided between gold and silver, and the ribbon streamers are half yellow and half gray. There are three 80-ampere 30-inch projecting lamps at each end of the building. The streamers are of different lengths and the projectors provided with color screens for varying the effect. Both the spectacular and useful illumination serves its particular purpose in a most eminently satisfactory manner, the former giving the desired fairyland effect, and the latter an unusually inviting and cozy appearance to the room.

The Calorific Standard for Gas

The incongruity of using candle-power as a standard for the quality of illuminating gas was commented on in these pages some two years ago, and the substitution of the calorific standard urged. This view has been gradually growing since that time, having been already adopted in one State. The matter is now to come up before the Public Service Commission of New York State, who will consider the advisability of recommending the necessary legislation to provide for the change of standards. This is a step in the right direction, and we trust will be carried to a successful conclusion.

Notes and Comments

Omaha Now Wants to Get Into the Spot Light

BUSINESS MEN ENDEAVOR TO GET APPROPRIATION FOR NEW INSTALLATION.

The movement for better street lighting shows no abatement, and there is no likelihood of it stopping until every city and town in the United States has its White Way. A new lighting contract is to be made by the city of Omaha, and its progressive citizens are anxious to take advantage of the fact to have a decorative system put in the heart of their city. According to a report in the *Bee* this seems to bid fair to succeed:

While the new lighting contract is pending in city council a movement is incubating to bring Omaha into line with other progressive cities in the matter of improved street lighting. If the men who are beginning the agitation can work up sufficient sentiment they will endeavor to have the council join in the endeavor to get established a permanent plan of decorative lighting for several main thoroughfares.

The general plan as at present contemplated would put new and better lights, probably on high ornamental posts. Undoubtedly, with a little effort, the existing sentiment can be organized sufficiently to bring about a condition of lighting on our main business streets that would put us in line with cities like St. Paul, Des Moines, Minneapolis and others, and we ought to go ahead of them, profiting by their experiment.

Buffalonians at Last See a Great Light

IT IS THE NEW ELECTRIC INSTALLATION IN THEIR CITY HALL.

Buffalo, the near-electric city, has made at least one step toward realizing the title which it laid claim to years ago when Niagara Falls was first utilized as a source of electric power; it has lighted up its City Hall with a modern installation of electric lamps, and a chandelier weighing a ton and a quarter. Some of the details are thus given by the *Express:*

The lighting fixtures are of cast bronze and of original design conforming to the moldings and trimmings throughout the building. In all there are 928 fixtures varying in number of lights from one to 60 and in weight from a few ounces to 2500 lbs., the last being hung in the aldermanic chamber.

The outside illumination is from seventeen new cast iron standards and four old ones of five lights each and fitted with 150-watt tungsten lamps.

Arkansas to Be a Good State to Travel In

FT. SMITH WILL VIE WITH WICHITA IN ITS NEW LIGHTING INSTALLATION.

The West has this important difference from the East: it has the spirit of rivalry. Even though cities may be a thousand miles apart they keep track of each other's doings, and in a friendly way try to outdo each other in general progress. The matter of better street lighting, which was taken up over a year ago in Wichita, has thus spread to Ft. Smith, according to the *Times:*

The Fort Smith Light & Traction Company have already sent one of their special electrical engineers on a trip to visit several cities that have just installed the "Great White Way." He has instructions to look into each installation very carefully and bring back to those interested the most complete and up-to-date plan to make Garrison avenue the best lighted main street in the Southwest. There is not the slightest doubt but what the local merchants can see the time coming when they will be forced to light up their places of business or take a back seat, and it is much easier to do something of their own free will than be forced to it by circumstances, so let them get busy and fall in line; now is the time to lead the parade of progress.

The advantages of using the "Great White Way" on Garrison avenue would be inestimable. If the "White Way" is installed the same results will be obtained as have been obtained in other cities, night traffic will be quadrupled, and goods displayed at night will be sold in the daytime.

Now is the time for the merchants of Fort Smith to get together and make this city the leading and most progressive one in the Southwest.

Chattanooga Needs More Light

A CINCINNATI VISITOR THERE GETS LOST IN THE DARK.

That a city is known by its lights is a truism which we have set forward many times in the past. The stranger who alights in town and has to grope his way around in the dark is not likely to carry away a glorious impression of that town. A Cincinnati man had this experience re-

cently in Chattanooga, according to the *News:*

"Is this the main stem?" inquired a portly gentleman from Cincinnati last night as he emerged from the Union Station on Ninth street.

"The main what?" asked the sympathetic bystander.

"The main stem is what I said," was the rejoinder; "by that I meant to inquire is this the principal street of Chattanooga, the main business street?"

"No," said a sympathetic bystander, "the principal business street is Market, just around the corner, and running at right angles to this thoroughfare."

The gentleman from Cincinnati then said that he saw the string of incandescent lights on East Ninth street running from the Guarantee Clothing Company to the office of the Southern Express Company, and that he noticed all the rest of the city in comparative darkness, so, of course, he supposed that the only illuminated street was the principal one. These lights on East Ninth street are about 18 in. apart. The lights are paid for by the merchants along the block.

After the gentleman from Cincinnati had deposited his two suit cases and sample bag in the hotel, wrote his name on the register and had been given a visiting card to one of the locker clubs, as is always done with guests from Cincinnati, he said:

"I like Chattanooga. This is getting to be a great big town, and, situated as it is, it will soon become a great city, but you certainly do have the poorest lighted streets here of any place I have ever seen that purported to be a real city."

Syracuse Takes a Hint from Western Cities

MANAGER OF ITS LIGHTING COMPANY STARTS A MOVEMENT FOR DECORATIVE STREET LIGHTING.

There is no doubt that in the matter of new street lighting the West has scored a decided scoop over the East; but some one always has to be first, and that the good example set by the West is not being lost upon the effete East is shown at least in the case of Syracuse, according to the *Post-Standard:*

General Manager James C. De Long of the Syracuse Lighting Company will inaugurate a campaign early next week for the placing of ornamental street lights throughout the important business streets of Syracuse. Mr. De Long said yesterday that his attention had been drawn to the matter by the enterprise of the business men of many other cities, notably in the Middle West, where in many instances ornamental lights are used to make the great commercial thoroughfares brilliant and attractive at night.

The *Herald* says very truly:

It is doubtful if there is a city in the country which has equal opportunity with Syracuse for spreading broadly a favorable reputation. The railroad which occupies one of the principal streets of this city is for many reasons objectionable, but as an offset it offers an opportunity for the city to advertise itself through the traveling public which should be made the most of. There are few ways in which a more favorable or lasting impression could be given than by a street lighting system of unusual or striking character if artistically well designed and executed.

Worth Mentioning

COMES HIGH, BUT THEY MUST HAVE IT.

The contract for lighting the famous board walk at Atlantic City has recently been let to the local lighting company at the rate of $12 per hour.

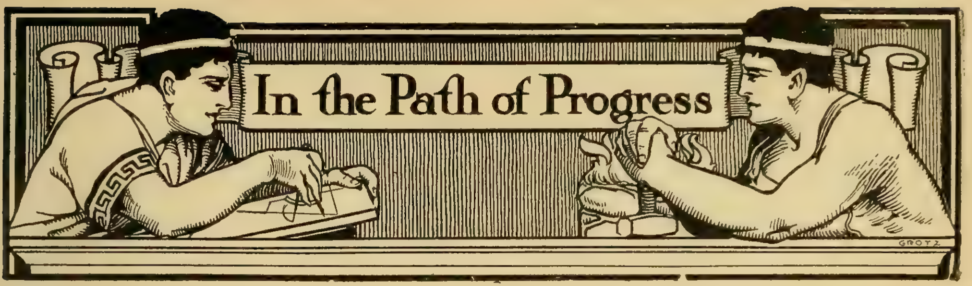
NEW YORK'S MAYOR ENTITLED TO TWO PORCH LIGHTS.

It is an immemorial custom, says the Brooklyn *Eagle,* to furnish the residence of the Mayor of New York with two porch lights. The Department of Water Supply, Gas and Electricity, in conjunction with the Bureau of Public Buildings of the Borough of Brooklyn, have models ready to show Judge Gaynor, and will install the lamps as soon as he has made a selection.

DARK SPOTS PRODUCE TOO MANY HOLD-UPS.

The Philadelphia *Record* complains that certain bridges along the river are so poorly lighted underneath as to furnish lurking places for footpads and ascribes numerous hold-ups and automobile accidents to this cause.

The village of Fulton, N. Y., has a "Boost Club," which is now working for better street lighting in the town.



Mazda

The announcement of a new trade-mark for a line of goods already familiar to the public is not in itself a matter of compelling interest to the public in general, or scientists and engineers in particular. The purpose of a trade-mark, at the last analysis, is simply a protection against sneak-thieves. It is comparatively easy to put one's physical possessions safely under lock and key; but that intangible and invaluable possession known as "reputation" is as little amenable to the arts of the locksmith as love is traditionally said to be. The commercial world is still infested with the tribe of camp followers who, lacking the ability to originate or the courage to lead, are content to lie in wait for such plunder as they may gather from the spoils of victory of those who have been in the front of the battle. No sooner has a particular manufacturer, or a manufactured article, made a reputation than these imitators appear stealthily with their whispers of "just as good," and "cheaper." As a warning, if not an absolute defense against these would-be purloiners, the trade-mark, or trade name, has come into use and legal recognition.

The tungsten lamp has marked a revolution in electric lighting; but contrary to the usual conditions with such epoch-making inventions, the methods of producing it have been so numerous that it has been impossible to control its production by patent right. The field has been open to all comers, and developments have shown that successful production is more a matter of skillful workmanship and conscientious inspection than of any particular method of producing the filament.

The two largest producers of lamps in this country have expended enormous sums on the work of investigating and perfecting this type of lamp, and it is very natural that they should wish to secure to themselves the commercial advantages of this preliminary work to the greatest possible extent; hence their adoption of a distinguishing trade name. What the word actually means is of little consequence. In this case it is taken from the ancient religion of Persia, signifying the sun-god, which stood for light in its moral and metaphorical sense.

Back of the adoption of this trade-mark, however, there are facts which are significant and noteworthy. The two parties using this name have each extensive research laboratories, which are manned by presumably the most competent investigators that money can secure, and equipped with every possible facility for modern scientific investigation. This fact, together with the expense of maintaining these institutions, is a most impressive object lesson as to the commercial value of pure science. Those who are wont to decry theory and vaunt the supremacy of practical knowledge will find the existence of these expensive and highly scientific equipments a serious blow to their pet theory. The case, however, is only more impressive because carried out on a larger scale. Closer search in any line of manufacture would reveal the fact that it originated in, and is based upon, theoretical science.

That the combined efforts of these two organizations should result in a product possessing to the highest possible degree all the excellencies of which it is physically and commercially capable might be reasonably expected. The trade name, therefore, in this case has more than usual

significance. It stands not simply for a particular product with a more or less established quality and reputation, but the result of the combined efforts of theoretical science and practical workmanship. Furthermore, it is not limited to a certain particular article of manufacture, but stands for scientific progress. The name, we are told, will be used to designate the best possible form of incandescent electric lamp which the combined efforts of the two companies is able to produce. At present such lamps use tungsten as the incandescent body. It is not only possible, but probable, that some better lamp may be discovered in the future, in which case the name will apply to the improved product.

A consideration of the general subject of scientific progress leads us to one other interesting and important conclusion, viz., that discovery and invention is something which it is impossible to predict, and equally impossible to control. Were every scientist and inventor of note gathered into a single institution, it would have no monopoly on scientific progress. The great battles of the world have not been won by strategy boards or councils of war, but by the genius of individual generals. Likewise have the great social and political revolutions been the result of personal initiative. The masterpieces of literature were not written to a bookseller's order, nor will great discoveries or inventions come at command. Genius is individual, and rises above all conventionalities and human laws. Though millions be expended, and hundreds of investigators set to the task of improving the means of producing light, we are more than likely to wake up some morning to find that some obscure workman, with the meager facilities producible by the labor of his own hands, has discovered a new source which renders all others obsolete. This observation is not made in disparagement of the very commendable practice of engaging competent scientists for the purpose of perfecting methods of manufacture, but rather to keep the ultimate truth before the everyday workman, that after all it is the individual that is supreme, and that the opportunities for original genius will never be closed.

A "Scoop" in Show Window Lighting

Many and devious are the methods of lighting the show window; some are good, many are bad. As the show window is the outward and visible sign of not only the wares, but the method of doing business of the merchant, it is of the highest importance that it should be of the best possible order. The problem has not been an easy one, and its successful handling has been expensive and often unsatisfactory. It is now generally recognized that concealed lighting of a sufficiently high intensity is the correct method.

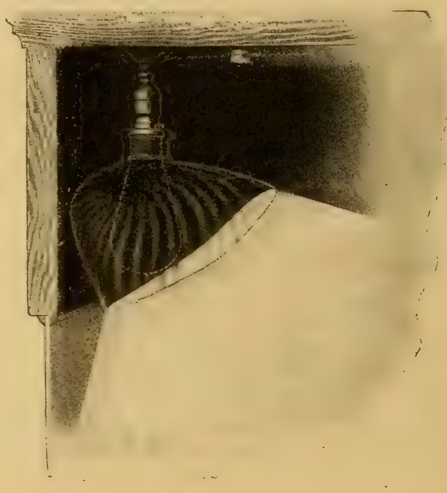


FIG. 1.—THE NEW "SCOOP" REFLECTOR

A very simple and effective device for the average case of show window lighting is announced by the National X-Ray Reflector Company, of Chicago. This consists of one of their silvered reflectors of a special type designed to direct the light downward and sufficiently far back to include the window space below. It is adaptable to the tungsten lamp and, as the illustration shows, requires nothing but the ordinary socket for its use. An installation can therefore be readily put in by any wireman or electrician. The manufacturers call this new reflector the "Scoop."

A New Type of Series Tungsten Lamp

The "missing link" in incandescent lamp making, which has troubled the manufacturers from the first appearance of the carbon lamp to the present time, is the connection between the leading-in wires and the filament. The patent records are full of devices for accomplishing this purpose in the case of the carbon lamp, and no little trouble has been experienced from the same source in the use of the tungsten filament.

FIG. I.—NEW GILMORE METHOD OF ANCHORING FILAMENTS.

The Gilmore Electric Company, of South Boston, Mass., whose product, though not widely heralded, has always been known among its users for its exceptionally high quality, have devised a method which, they claim, and with apparently very sufficient reason, entirely obviates the trouble with loose joints. The filament is given two or three turns about the enlarged end of the leading-in wire, and a perfect electrical and physical contact made between the two with a special metallic compound.

A chain is only as strong as its weakest link, and an incandescent lamp is no stronger than its joints. The improvements, which are illustrated herewith, therefore seems to be of really vital importance.

A Successful Small-Carbon Enclosed Arc Lamp

After a precarious career of some years the small-carbon enclosed arc lamp seems to be making substantial headway. Its higher efficiency and neater appearance, together with the daylight quality of the illumination when furnished with the proper globe, especially recommend it for interior illumination, particularly that of stores.

A lamp of this type which is meeting with success is known as the "Daylight" lamp, and is manufactured by the Volkmer Electrical Company, New York City. The lamp is of simple but substantial design, with all the mechanical and electrical parts well made and carefully proportioned. Special reflectors and globes are provided so as to adapt it to any particular case of illumination. The fact that it has satisfied the exacting demands of such institutions as the United States Government, the American Bank Note Company, and the New York *Herald* shows that it is no experiment or toy, but a practical lighting unit.

THE NEW "DAYLIGHT" LAMP.

"The Lighting of Mills and Factories"

This is the title of a booklet recently issued by the Holophane Company, Newark, Ohio. While commercial pamphlets are literally "too numerous to mention" individually in these columns, an exception is occasionally made where there seems to be distinct merit. In this case the subject is treated from the strictly engineering standpoint, the facts being made clear both by reproductions of photographs taken by actual illumination, by diagrams and by unusually clear descriptions. The pamphlet properly belongs among technical literature on the subject of illuminating engineering, and as such should be in the possession of all interested in the subject.

Proceedings of Technical Societies

DR. E. P. HYDE

The Illuminating Engineering Society

The annual meeting of the society took place in the rooms of the Machinery Club, Hudson-Terminal Building, New York City, on the evening of January 14. The report of the Committee of Tellers on Election of Officers showed that the ticket put in nomination by the Nomina-

tion Committee was elected with practical unanimity.

The retiring president, Mr. W. H. Gartley, spoke briefly of the work of the society during the year, expressing his gratification not only at the steady progress of the society itself, but of interest in the science for which it stands, particularly among the gas industries. The gas interests beyond doubt, he stated, have largely awakened to the importance of applying illuminating engineering to their business, as is shown by the establishment of photometric laboratories and the employment of professional illuminating engineers.

Mr. E. N. Wrightington, recently elected president of the National Commercial Gas Association, brought out clearly the commercial importance of utilizing illuminating engineering principles in the conduct of the gas interests.

Mr. F. S. Terry, of the National Electric Lamp Association, briefly dwelt upon the fact that the illuminating field is so large and important as to offer ample opportunities for all competing interests to work in harmony, and that in promoting the cause of better lighting all would be benefited.

Mr. Walter R. Addicks discussed in a general way the value of the work which the society is doing.

Dr. E. P. Hyde, though prefacing his remarks with a general disclaimer of preparation, made a characteristically pointed and enjoyable address. Quoting the objects of the society as set down in the constitution, Dr. Hyde spoke of the necessity of considering both theory and practice in the advancement of the profession and the society, and outlined briefly the line of study those aspiring to the title of illuminating engineer should follow.

The report of the committee appointed a year ago to investigate the feasibility of dividing the membership so as to distinguish the specialist, or practicing illuminating engineer, from the amateur or beginner, was presented by the chairman, Mr. E. L. Elliott. The report was short and to the effect that while the committee were unanimous in recommending such a division, it had not reached a definite conclusion as to the details of carrying it out, and recommended that the matter be put over until the next annual convention. A motion to this effect was afterward made and carried.

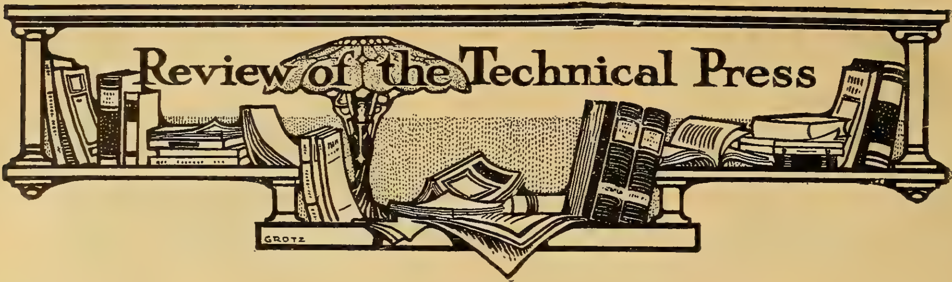
The New England Section met on Monday, January 17. The evening was taken up by an address by Mr. E. L. Elliott on the "Elements of Illuminating Engineering." The speaker went briefly over the mathematical and theoretical elements of the subject, giving such explanations as would tend to make the matter clear in the minds of those not familiar with highly technical demonstrations. The subject was chosen in response to a general inquiry among the members for such an elementary review of the fundamentals to the subject.

The New York Section meet in the United Engineering Societies Building on Thursday evening, January 20. A paper on "The Lighting of a Bowling Alley" was presented by Mr. Thomas W. Rolph, and an address, illustrated with lantern views, on "Selling Electric Light," by Mr. T. I. Jones. The meeting was largely attended and the discussion of the subject vigorous and spirited. Mr. Rolph described the lighting installation of a bowling alley in which tungsten lamps and metallic reflectors were used. Mr. Jones gave a complete analysis of different forms of contracts for electricity for light and power as used in New York, Philadelphia, Boston and Chicago, and explanations of the theory and practice of arranging rate schedules.

The meeting of the Philadelphia Section was held on Friday evening, January 21. A paper was presented by Dr. Herbert E. Ives on "Illuminating Efficiencies of Light Sources."

Chicago Electric Club

At the regular noonday luncheon of the Chicago Electric Club, on January 12, Mr. George C. Keech gave a talk on the mercury vapor lamp. After briefly relating the history of the mercury vapor lamp as developed by Mr. Peter Cooper Hewitt, Mr. Keech put his hearers in good humor by relating some amusing incidents in connection with the lamp on account of the peculiar color of its rays. He then proceeded to give a brief discussion of various cases in which the peculiar qualities of the mercury vapor lamp.



American Items

Annual Report of the Electrical Department of the District of Columbia for the Fiscal Year Ending June 30, 1909.

This report, compiled by the Electrical Engineer of the District, Mr. Walter C. Allen, has been issued by the Government Printing Office. As has been noted from time to time, the subject of improving the street lighting in Washington, D. C., has been given much study and experimental attention during the past year. The results of this work are fully given in Mr. Allen's report, which forms an exceedingly valuable addition to the literature of this important field of illuminating engineering. Illustrations of typical lamp posts are given, together with tabulated data of numerous illuminometer measurements made in the streets.

A Semi-Concealed Church Lighting Installation; *Electrical World*, December 30.

Describes the installation in a building constructed for a church, now used as a Jewish institute, in which the light-sources were largely concealed from the audience by being placed high in the pointed arches of the roof.

The Disadvantages and Dangers from the Use of Gasoline for Interior Illumination, by Jack T. Connors; *Electrical World*, January 6.

A very complete presentation of the case against gasoline for indoor lighting.

An Exemplary Boulevard Illumination; *Electrical Review and Western Electrician*, December 25.

A description of the installation recently put in on the Lincoln Park boulevard, Chicago.

Street Lighting in the City of New York, by H. Thurston Owens; *Electrical Review and Western Electrician*, January 1.

Gives statistics as to the number and kinds of lamps used in the city, and illustrations of typical lamp posts with carbon, tungsten, and arc lamps.

Tungsten Lamps for Residence Illumination, by Charles T. Phillips; *Electrical Review and Western Electrician*, January 8.

Treats particularly of the use of low voltage small candle-power tungsten lamps for residence use.

Tantalum Lamps for the Lighting of Ships, by Dr. Alfred Gradenwitz; *Electrical Review and Western Electrician*, January 15.

The ability of this form of high efficiency lamp to withstand the vibration incident to ships is brought out, together with the advantages of the reduction in current consumption.

Fixed Charges for Fixed Expenses to Meet the Tungsten Lamp Situation, by S. E. Doane; *Central Station*, January.

Mr. Doane makes a somewhat elaborate analysis of the subject in an attempt to solve the knotty problem of how the central station shall recoup itself for the loss of current represented by the tungsten lamp. With two of his introductory statements not all will be inclined to agree. "The tungsten lamp," he says, "is

the most efficient method of transforming dollars into light for domestic service that the world has ever known." Our gas friends may have something to say on this question. And again, "Electricity is not a commodity." His argument in substantiation of this statement, while plausible, may likewise be subject to dispute:

"For many, many years previous to the advent of gas and electricity, men have purchased as a commodity the wherewithal to produce light. When you purchase a candle you purchase that which may be considered to be the equivalent, both of the electricity and the lamp, but the service item is not included. When you purchase kerosene oil you purchase that which is equivalent to the electricity alone, neither the service nor the lamp are included."

Mr. Doane then gives a careful analysis of the cost of producing light with carbon and tungsten lamps, but while broadly claiming that the latter offers the cheapest method of producing light for domestic use, gives no figures in regard to gas.

THE CONFIDENCE-BUILDING WINDOW DISPLAY, by H. W. Chase; *Electrical Record,* January.

Describes the window display used by the Dayton Lighting Company, showing examples of good and bad lighting, both for show windows and the home.

APPLYING THE "LIGHT OF WELCOME," by Earl E. Whitehorne; *Selling Electricity,* January.

An illustrated article on electric signs for hotels.

ENCLOSED ARC LIGHT EXPERIENCE; *Electrocraft,* January.

Describes a case of the unsatisfactory working of a number of arc lamps running in parallel due to overloading of feed wires.

ELECTRICAL EQUIPMENT OF AN ARMORED CRUISER, by L. St. D. Roylance; *Journal of Electricity, Power and Gas,* January 1.

The article includes a complete description of all the lighting apparatus used.

INVESTIGATION OF THE METHODS OF CAR LIGHTING, by Edward Wray; *Railway Electrical Engineer,* January.

A continuation of the report of the work on this subject which was done by Mr. Wray in connection with graduating students of the University of Wisconsin in 1906.

A NEW BERTH LIGHT; *Railway Electrical Engineer,* January.

This new light consists of a small tungsten lamp, which remains in a fixed position, with a small prismatic hemispherical globe placed in front and pointing at an angle of about 30 degrees below the horizontal, by which the rays are directed into the best direction for the passenger's use. A small push switch operates the lamp.

A NEW LIGHTING INVENTION OF INTEREST TO "CURLERS"; *Canadian Electrical News,* January.

The object of the invention and the novel method of its achievement is thus described:

"Some two years ago, Mr. R. S. Kelsch, consulting engineer, Montreal, was called in by the Montreal Curling Club to devise a scientific system of lighting for the club's rink. After considerable experimenting, Mr. Kelsch was convinced that the modern lighting methods brought out a defect which seriously interfered with the game of curling, and that was—the color of the ice due to the method of freezing, and particularly to the background of the ice.

"To overcome this defect, a roll of white paper such as is used for printing newspapers was secured, and with this the ground was carpeted and a sheet of ice formed over the paper. The results achieved were simply wonderful, the ice taking on a mirror-like appearance.

"By the change the curling stone was made more conspicuous and the uniform surface gave a uniform speed to the stone, obviating the trouble experienced prior to the use of the paper, where the stone appeared to move faster or slower, according to the color of the ice."

STYLES OF WINDOW LIGHTS, by "Inspector"; *American Gas Light Journal,* January 10.

A short article treating of the forms of windows where all-night illumination is used for safety or other purposes.

PRACTICAL DEMONSTRATION OF THE GAS ARC LIGHT, by "Inspector"; *American Gas Light Journal,* January 17.

Sets forth briefly the special field of the gas arc, and dwells upon effective means of its commercial demonstration.

Foreign Items

Compiled by J. S. Dow

ILLUMINATION.

The Inaugural Meeting of the Illuminating Engineering Society Held in London, November 18, 1909.

A full account of this meeting will be found in the *Illuminating Engineer* (London) for December. It includes the presidential address, the report of the council, and list of members up to date. It is impossible in the space available to give any adequate abstract of the presidential address. It was devoted mainly to an explanation of the aims of the society and has been widely reported elsewhere in the press.

EDITORIALS.

Illuminating Problems (*Electrician*, Nov. 26).

The Illuminating Engineering Society (*Gas Engineer's Magazine*, Nov. 15, Dec. 15).

Illuminating Agents (*J. G. L.*, Nov. 30).

The above editorials are mainly devoted to the Illuminating Engineering Society and speak of its prospects very favorably. Some other comments were mentioned in the last review.

Light in Custom and Superstition, by Dr. M. Gaster; (*Illum. Engineer*, Lond., Dec.).

The author proceeds a step further in his analysis of religious and superstitious ideas connected with light and shows how the connection established between light and immortality also led to the association of the appearance of ghosts and demons with luminous effects. For example, we speak of "seeing a ghost" always, and the very name given to the Prince of Evil, "Lucifer," is also symbolic.

Modern Methods of Illumination, by L. Gaster (lecture delivered at London Institution, Nov. 22; reported *Illum. Eng.*, Lond., Dec.).

The lecture is intended to be a popular summary of the chief modern systems of lighting and their use. The lecturer, however, dwelt especially on the need for a standard specification for illuminating apparatus.

Konstruktion der Bodenbeleuchtungskurven aus der Lichtstärkekurve, by J. Sumec (*Elek. u. Masch.*, Dec. 5).

The author summarizes the chief methods of constructing graphically the curves of ground illumination from the polar curve of light distribution of an illuminant. He illustrates his method by working out the illumination curve between two flame arcs of the Excello type at a given height and a specified distance apart. He also points out that when the dioptric globe is used the best theoretical height of the lamps, at the usual distance apart, works out to about 11 metres . . . a reasonable value. But if no dioptric globe were used the lamps would have to be placed at the inconvenient height of about 23 metres to get the same result.

Die feuerfesten Stoffe und die Heizungs- und Beleuchtungstechnik, by O. Vogel (*Z. f. B.*, Dec. 10).

Streetlighting at Handsworth (*Gas Engineer's Magazine*, Nov. 15).

Le Rendement des Sources Lumineuses (*Rev. des Eclairages*, Nov. 15).

Fortschritte im Beleuchtungs- und Lüftungswesen des Bergwerkbetrieben (*Z. f. B.*, Dec. 10).

PHOTOMETRY.

Light and Some Reflections, by J. Abady (*J. G. L.*, Dec. 14; *Gas World*, Dec. 18).

The lecturer dealt with the fundamental laws of photometry and their limitations in actual measurement. He also laid stress on the desirability of avoiding "empirical" methods of measurement. Finally he describes his own type of "street-photometer," in which the varia-

tion in the illumination of the photometer-disc is achieved, not by altering the distance of the comparison source, but by altering the area of an illuminated surface exposed.

THE FLICKER PHOTOMETER, by H. Morris Airey (*Electrician*, Dec. 17).

THE FLICKER PHOTOMETER AND THE EYE, by J. S. Dow (*J. G. L.*, Nov. 30; *Electrician*, Nov. 26).

These two contributions deal with the question of the physiological theory underlying the flicker photometer. H. Morris Airey endeavors to explain the action of the flicker instrument on the supposition that retinal impulses due to the three primary colors die away at different rates.

The second item is devoted to the discussion raised after the recent paper by J. S. Dow before the Physical Society.

EDITORIALS.

MR. ABADY ON PHOTOMETRY (*G. W.*, Dec. 18; *J. G. L.*, Dec. 21).

ILLUMINATION MEASUREMENTS (*Gas Engineer's Magazine*, Nov. 15).

UBER DIE EINHEIT DER BELEUCHTUNGSSTÄRKE, by B. Monasch (*J. f. G.*, Dec. 11).

The author traces the development of the term "lux" and shows how two possible interpretations of this term may be found to exist. He concludes his article by a table comparing the units of intensity of illumination prevailing in different countries as they now stand in terms of the international unit of light.

ILLUMINATION, ITS DISTRIBUTION AND MEASUREMENT, by A. P. Trotter. (Continued.) (*Illum. Eng.*, Lond., Dec.).

The author describes in detail various patterns of Trotter illumination photometer.

ELECTRIC LIGHTING.

DIE WIRKUNG DES ELEKTRISCHEN LICHTES BEI DEM SCHAUFENSTER-WETTBEWERB IN BERLIN, by P. Behrens (*A. E. G. Zeitschr.*, Nov.).

Describes several methods of shop lighting on view at a recent exhibition in Berlin. Some attractive illustrations accompany the article.

EDITORIAL.

THE PRESENT ASPECTS OF ELECTRIC LIGHTING (*Elec. Review*, Nov. 26).

UBER NEUERE FLAMMENBOGENLAMPEN, by P. Heyck (*E. T. Z.*, Nov. 4, 11).

A very complete account of the newest types of flame arc lamps of Messrs. Körting and Mathiesen. Polar curves of light distribution of various types of lamps, both direct current and alternating, and with and without the dioptric globe, are given.

LA LAMPE A FILAMENT METALLIQUE, by Henry (*Electrician*, Nov. 20; *Rev. des Eclairages*, Dec. 15, etc.).

TRANSFORMATEURS ET INTERRUPTEURS AUTOMATIQUES POUR LAMPES À FILAMENT METALLIQUE, by Marchand (*Electricien*, Dec. 4).

DAS NEUE DIAZED-SICHERUNGSSYSTEM UND SEINE ENTSTEHUNG, by P. H. Perls (*Elek. u. Masch.*, Dec. 12).

ELECTRICITY IN CHURCHES, by G. Siegel (*A. E. G. Zeitschr.*, Dec.).

Describes some electrical installations in churches. It is interesting to observe that in a number of cases arc lamps are used, a somewhat striking example of the use of the new illuminants in old interiors.

METALLIC FILAMENT LAMPS, by G. Wilkinson and R. McCourt (*Elec. Engineer*, Dec. 17).

Discusses the effect of metallic filament lamps on the revenue of the company at Harrogate, and puts forward a number of figures comparing their costs with arc lighting, etc.

LAMPE À ARC (*Le Moniteur de l'Industrie du Gax*, etc., Oct. 31).

DIE GLÜHLAMPEN-EINKAUFSVEREINIGUNG DES VERBANDES SCHWEIZERISCHER ELEKTROTECHNIKER (*J. f. G.*, Nov. 27).

Gives some account of the work of the Union controlling the sale of glow lamps in Switzerland. The tests carried out by the Union have, it is said, had very bene-

ficial results, and agree well with those instituted by manufacturers. One point emphasized is that short-life overrunning tests on glow lamps are unsatisfactory. Lamps must be tested for life at normal voltage.

SOME POINTS IN RELATION TO ARC LAMPS (*Elec. Rev.*, Dec. 17).

THE A B C FLAMING ARC (*Electricien*, Nov. 13).

METALLIC FILAMENT LAMPS (*Elec. Engineer*, Dec. 3).

GAS, OIL, ACETYLENE LIGHTING, ETC.

EDITORIALS.

THE NEW TEST BURNER BILL (*G. W.*, Nov. 27).

GAS LEGISLATION FOR 1910 (*G. W.*, Dec. 4).

NEUHEITEN AUF DEM GEBIETE DER INVERTBELEUCHTUNG, by M. Scholz (*J. f. G.*, Dec. 25).

The author dwells upon the value of the inverted mantle both for interiors and for street lighting. In the latter case, he states, the shape of the polar curve of light distribution is favorable to street lighting and the Grätzin incandescent gas lights can be hung at a lower height than flame arcs.

SPANNVORRICHTUNGEN U. GELENKKANDELABER FÜR NIEDERDRUCK UND PRESSGAS-INVERTLAMPEN, by D. Witt (*J. f. G.*, Dec. 18).

Describes some of the recent methods of slinging high and low pressure gas lamps on wires spanning the street, etc.

GASZÜNDVORRICHTUNGEN (5), CHEMISCH WIRKEND ZÜNDER (*Z. f. B.*, Nov. 30).

CHURCH LIGHTING BY INVERTED BURNERS (*G. W.*, Nov. 20).

UNTERSUCHUNG ÜBER DEN EINFLÜSS DES CERGEHALTES BEI GLÜHKORPERN (*Z. f. B.*, Nov. 30).

Discusses the researches of Lux on the effect of altering the percentage of cerium in mantles. It is generally believed that the amount of cerium should not be reduced below 0.8 per cent., though a special new process is supposed to render this less vital. Lux, however, finds that the radiant efficiency of the mantle was reduced from 0.501 to 0.142 per cent. when the amount of cerium was reduced to only 0.1 per cent.

THE DACOLIGHT REGENERATIVE LAMP (*J. G. L.*, Dec. 7; *G. W.*, Dec. 18).

THE DACOLIGHT CONTROLLER (*G. W.*, Dec. 11).

THE AUTOMATIC LIGHTING OF PUBLIC LAMPS (*J. G. L.*, Dec. 14).

INCANDESCENCE MANTLES (*J. G. L.*, Dec. 14).

Refers to a method of making mantles according to which the incandescent material is deposited on a quartz core. The resulting mantle is believed to be exceptionally durable.

THE AUTOMATON LAMP CONTROLLER (*G. W.*, Nov. 20).

APROPOS D'INCANDESCENCE (*Rev. des Eclairages*, Nov.)

L'ECLAIRAGE DES FERMES ET CHATEAUX (*Jour. de l'Union des Proprietaires d'Appareils à Acetylene*, Oct.).

Contractions used:
E. T. Z. ***Elektrotechnische Zeitschrift.***
G. W. ***Gas World.***
Illum. Eng., Lond. ***Illuminating Engineer (London).***
J. G. L. ***Journal of Gaslighting.***
J. f. G. ***Journal für Gasbeleuchtung und Wasserversorgung.***
Z. f. B. ***Zeitschrift für Beleuchtungswesen.***